

SECTION 00 01 01 - PROJECT MANUAL

FOR

**ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE
NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION
2049 SUNDANCE PARKWAY
NEW BRAUNFELS, TEXAS 78130**

VOLUME 1

**BIDDING AND CONTRACT REQUIREMENTS
AND
SPECIFICATIONS**

FOR THE

**ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE
1201 KITTY HAWK RD, FACILITIES DEPARTMENT
UNIVERSAL CITY, TEXAS 78148**

**ISSUE FOR BID
SEPTEMBER 24, 2025**

PBK PROJECT NUMBER: 250033

**PREPARED BY:
PBK ARCHITECTS, INC.
601 NW LOOP 410, SUITE NO. 400
SAN ANTONIO , TEXAS 78216**

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SECTION 00 01 02 - PROJECT INFORMATION

PART 1 GENERAL

1.1 PROJECT IDENTIFICATION

- A. Project Name: Northeast Lakeview College, Sundance Renovation, located at:
2049 Sundance Parkway.
New Braunfels, Texas 78130.
- B. Owner, hereinafter referred to as the "Owner": Alamo Colleges District - Northeast Lakeview College

1.2 PROJECT DESCRIPTION

- A. Refer to Section 01 10 00 - Summary.

1.3 PROCUREMENT TIMETABLE

- A. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

1.4 PROCUREMENT DOCUMENTS

- A. Availability of Documents: Complete sets of procurement documents may be obtained:
 - 1. From Owner at the Project Manager's address listed above.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00 01 02

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SECTION 00 01 07 - SEALS PAGE

NOTE:

INDICATION OF RESPONSIBILITY BY DISCIPLINE

Letters indicated in parenthesis next to disciplines below indicate responsibility for Sections listed in the Table of Contents.

OWNER (O)

OWNER'S NAME: ALAMO COLLEGE DISTRICT.

Owner's Designated Representative (ODR): Javier Dominguez.

Address: 1201 Kitty Hawk Rd.

City, State ZIP: Universal City, Texas 78148.

No Seal Required.

LANDSCAPE ARCHITECT (L)

COMPANY NAME: EDGELAND GROUP

Registered Landscape Architect: Jacob T. Galles, R.L.A. #3022.

Address: 11 Greenway Plaza.

City, State ZIP: Houston Texas 77046.

ARCHITECT (A)

COMPANY NAME: PBK ARCHITECTS, INC.

Texas Registered Firm BR-1608.

Registered Architect: Clifford Whittingstall, R.A. #18585.

Address: 601 NW Loop 410, Suite No. 400.

City, State ZIP: San Antonio , Texas 78216.

Telephone Number: 210-829-0123.

ROOFING / BUILDING ENVELOPE (R)

COMPANY NAME: BEAM PROFESSIONALS

Registered Roof Consultant: Shawn LeCrone, IIBEC #0889.

Address: 601 NW Loop 410, Suite 400.

City, State ZIP: San Antonio, Texas 78216.

MECHANICAL ENGINEER (M)

COMPANY NAME: LEAF ENGINEERS.

Texas Registered Engineering Firm F-18672.
Engineer of Record: James R. Perron, P.E. #145042.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-698-6455.

ELECTRICAL AND PLUMBING ENGINEER (E P)

COMPANY NAME: LEAF ENGINEERS

Texas Registered Engineering Firm F-18672.
Engineer of Record: Donald C Richards, P.E. #61525.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-698-6455.

TECHNOLOGY (T)

COMPANY NAME: DATACOM DESIGN GROUP

Technology Designer: John Rob Hicks, BICSI #200774.
Address: 7551 Callaghan Rd., Suite 105.
City, State ZIP: San Antonio, Texas 78229.
Telephone Number: 210-698-6455.

DOOR HARDWARE (H)

COMPANY NAME: ALLEGION

Product Representative: Marcus McElreath.
City, State ZIP: San Antonio, Texas.
Telephone Number: 254-595-3928.
No Seal Required.

END OF SECTION 00 01 07

SECTION 00 01 10 - TABLE OF CONTENTS

GENERAL

RESPONSIBILITY

Each section is the responsibility of the discipline indicated by the letter in parenthesis following the section name as indicated in Section 00 01 07 - Seals Page with the following exceptions:

(O): Section provided by Owner.

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

- 00 01 02 - Project Information (A)
- 00 01 07 - Seals Page (A)
- 00 01 10 - Table of Contents (A)
- 00 31 00 - Available Project Information (A)
- 00 40 13 - Affidavit of Non-Discriminatory Employment (A)
- 00 40 14 - Affidavit of Non-Asbestos, Lead, and PCB Use (A)
- 00 40 17 - Certification of Criminal History Record Information Review (A)
- 00 45 19 - Non-Collusion Affidavit (A)
- 00 50 00 - Texas Statutory Performance Bond (A)
- 00 50 01 - Texas Statutory Payment Bond (A)
- 00 65 19.16 - Affidavit of Release of Liens Form (A)
- 00 73 43 - Wage Rate Requirements (Texas) (A)
- 00 73 46 - Wage Determination Schedule (A)

DIVISION 01 - GENERAL CONDITIONS

- 01 23 00 - Alternates (A)
- 01 25 13.01 - Request for Substitution Form (A)
- 01 26 00 - Contract Modification Procedures (A)
- 01 29 00 - Payment Procedures (A)
- 01 40 00 - Quality Requirements (A)
- 01 41 00 - Regulatory Requirements (A)
- 01 50 00 - Temporary Facilities and Controls (A)
- 01 55 00 - Vehicular Access and Parking (A)
- 01 56 00 - Temporary Barriers and Enclosures (A)
- 01 56 39 - Tree Pruning Fertilizing and Protection (L)
- 01 60 00 - Product Requirements (A)
- 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions (A)
- 01 73 00 - Execution (A)
- 01 73 29 - Cutting and Patching (A)
- 01 74 19 - Construction Waste Management and Disposal (A)
- 01 77 00 - Closeout Procedures (A)
- 01 77 01 - Closeout Form A - Subcontractor's Affidavit of Release of Lien (A)
- 01 77 02 - Closeout Form B - Subcontractor Hazardous Material Certificate (A)

01 77 03 - Closeout Form C - Subcontractor Warranty (A)

01 91 13 - General Commissioning Requirements (A)

DIVISION 02 - EXISTING CONDITIONS

02 41 00 - Demolition (A)

DIVISION 03 - CONCRETE

03 35 00 - Concrete Finishing (A)

03 54 00 - Cast Underlayment (A)

03 35 23 - Exposed Aggregate Concrete Finish (L) (L)

DIVISION 04 - MASONRY

NOT USED

DIVISION 05 - METALS

05 50 00 - Metal Fabrications (A)

05 75 00 - Decorative Formed Metal (A)

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00 - Rough Carpentry (A)

06 16 00 - Sheathing (A)

06 20 00 - Finish Carpentry (A)

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 05 43 - Cladding Support Systems (A)

07 21 00 - Thermal Insulation (A)

07 25 00 - Weather Barriers (A R)

07 46 19 - Steel Siding (A)

07 46 46 - Fiber-Cement Siding (A)

07 54 19 - Fully Adhered (TPO) Membrane Roofing (A R)

07 62 00 - Roof Related Sheet Metal (A R)

07 71 23 - Manufactured Gutters and Downspouts (A)

07 72 00 - Roof Accessories (A R)

07 84 13 - Penetration Firestopping (A)

07 84 43 - Joint Firestopping (A)

07 92 00 - Joint Sealants (A)

07 95 13 - Expansion Joint Cover Assemblies (A)

DIVISION 08 - OPENINGS

08 11 13 - Hollow Metal Doors and Frames (A)

08 11 16 - Aluminum Doors and Frames (A)

08 13 16 - Aluminum Doors (A)

08 14 16 - Flush Wood Doors (A)

08 31 00 - Access Doors and Panels (A)

08 42 43 - Intensive Care Unit / Critical Care Unit Entrances (A)

08 43 13 - Aluminum-Framed Storefronts (A)

- 08 63 00 - Metal-Framed Skylights (A)
- 08 71 00 - Door Hardware (H)
- 08 71 13 - Power Door Operators (A)
- 08 80 00 - Glazing (A)

DIVISION 09 - FINISHES

- 09 05 00 - Common Work Results for Finishes (A)
- 09 05 61 - Common Work Results for Flooring Preparation (A)
- 09 21 16 - Gypsum Board Assemblies (A)
- 09 24 00 - Cement Plastering (A)
- 09 30 00 - Tiling (A)
- 09 51 00 - Acoustical Ceilings (A)
- 09 65 00 - Resilient Flooring (A)
- 09 65 13 - Resilient Base and Accessories (A)
- 09 67 00 - Fluid-Applied Flooring (A)
- 09 81 00 - Acoustic Insulation (A)
- 09 84 00 - Acoustic Room Components (A)
- 09 90 00 - Painting and Coating (A)
- 09 97 23 - Concrete and Masonry Coatings (A)

DIVISION 10 - SPECIALTIES

- 10 11 00 - Visual Display Units (A)
- 10 14 00 - Signage (A)
- 10 21 23 - Cubicle Curtains and Track (A)
- 10 22 19 - Demountable Partitions (A)
- 10 26 00 - Wall and Door Protection (A)
- 10 28 00 - Toilet, Bath, and Laundry Accessories (A)
- 10 43 00 - Emergency Aid Specialties (A)
- 10 44 00 - Fire Protection Specialties (A)
- 10 51 26 - Plastic Lockers (A)
- 10 55 00 - Postal Specialties (A)
- 10 56 13 - Metal Storage Shelving (A)
- 10 56 17 - Wall-Mounted Standards and Shelving (A)
- 10 73 16.13 - Metal Canopies (A)
- 10 75 00 - Flagpoles (A)
- 10 81 13 - Bird Control Devices (A)
- 10 82 13 - Exterior Grilles and Screens (A)

DIVISION 11 - EQUIPMENT

- 11 30 13 - Residential Appliances (A)
- 11 46 83 - Ice Machines (A)
- 11 53 00 - Laboratory Equipment (A)

- 11 53 13 - Laboratory Fume Hoods (A)
- 11 70 00 - Healthcare Equipment (A)
- 11 81 29 - Facility Fall Protection (A)
- 11 90 00 - Miscellaneous Equipment (A)

DIVISION 12 - FURNISHINGS

- 12 11 13 - Photo Murals (A)
- 12 21 13 - Horizontal Louver Blinds (A)
- 12 35 53.19 - Wood Laboratory Casework (A)
- 12 36 00 - Countertops (A)

DIVISION 13 - SPECIAL CONSTRUCTION

- 13 34 19 - Metal Building Systems (A)

DIVISION 14 - CONVEYING EQUIPMENT

NOT USED

DIVISION 21 - FIRE SUPPRESSION

- 21 05 00 - Common Work Results for Fire Suppression (P)

DIVISION 22 - PLUMBING

- 22 05 00 - Common Work Results for Plumbing (P)
- 22 05 10 - Sanitary Pipe Testing (P)
- 22 05 12 - Water Pipe Testing (P)
- 22 05 16 - Expansion Fittings and Loops for Plumbing Piping (P)
- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment (P)
- 22 05 48.13 - Vibration Controls for Plumbing Piping and Equipment (P)
- 22 08 00 - Commissioning of Plumbing (P)
- 22 11 16 - Domestic Water Piping (P)
- 22 13 16 - Sanitary Waste and Vent Piping (P)
- 22 13 21 - Acid Waste And Vent Systems (P)
- 22 15 13 - Compressed-Air Piping (P)
- 22 20 23 - Gas Piping (P)
- 22 30 00 - Plumbing Equipment (P)
- 22 40 00 - Plumbing Fixtures (P)
- 22 51 00 - Laboratory Safety Device System (P)
- 22 60 53 - Laboratory Vacuum And Gas Piping (P)
- 22 61 13 - Compressed-Air Piping for Laboratory and Healthcare Facilities (P)
- 22 67 13 - High Purity Water Systems (P)

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- 23 05 00 - Common Work Results for HVAC (M)
- 23 05 13 - Common Motor Requirements for HVAC Equipment (M)
- 23 05 29 - Hangers and Supports for HVAC Piping and Equipment (M)
- 23 05 53 - Identification for HVAC Piping and Equipment (M)

- 23 05 93 - Testing, Adjusting, and Balancing for HVAC (M)
- 23 07 13 - Duct Insulation (M)
- 23 08 00 - Commissioning of HVAC (M)
- 23 09 23 - Direct-Digital Control System for HVAC (M)
- 23 09 93 - Sequence of Operations for HVAC Controls (M)
- 23 31 13 - Metal Ducts (M)
- 23 33 00 - Air Duct Accessories (M)
- 23 34 00 - HVAC Fans (M)
- 23 34 23 - High Plume Blower Systems (M)
- 23 34 39 - High-Volume, Low-Speed Propeller Fans (A)
- 23 37 13 - Diffusers, Registers, and Grilles (M)
- 23 74 13 - Packaged, Outdoor, Central-Station Air-Handling Units (M)
- 23 81 26 - Ductless Mini-Split-System Air-Conditioners (M)

DIVISION 25 - INTEGRATED AUTOMATION

NOT USED

DIVISION 26 - ELECTRICAL

- 26 05 00 - Common Work Results for Electrical (E)
- 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (E)
- 26 05 26 - Grounding and Bonding for Electrical Systems (E)
- 26 05 29 - Hangers and Supports for Electrical Systems (E)
- 26 05 33 - Raceway and Boxes for Electrical Systems (E)
- 26 05 53 - Identification for Electrical Systems (E)
- 26 08 00 - Commissioning of Electrical Systems (E)
- 26 09 14 - Electrical Controls (E)
- 26 09 23 - Lighting Control Devices (E)
- 26 20 00 - Electrical Distribution Equipment (E)
- 26 27 26 - Wiring Devices (E)
- 26 43 00 - Surge Protective Devices (E)
- 26 50 00 - Lighting (E)

DIVISION 27 - COMMUNICATIONS

- 27 00 00 - Basic Materials And Methods (T)
- 27 10 00 - Structured Cabling (T)
- 27 41 13 - Audio Visual Systems (T)
- 27 60 00 - Physical Security General Requirements (T)

DIVISION 28 - SAFETY AND SECURITY

- 28 05 00 - General Electronic Safety Systems Requirements (T)
- 28 05 44 - Emergency Responder Radio Antenna System (T)
- 28 10 00 - Access Control (T)
- 28 16 00 - Intrusion Detection System (T)

28 23 00 - Security Camera Surveillance System (T)

28 31 00 - Fire Alarm System (T)

DIVISION 31 - EARTHWORK

NOT USED

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 13 14 - Pedestrian Concrete Paving (L)

32 15 40 - Gravel Paving (L)

32 31 13 - Chain Link Fences and Gates (A)

32 31 19 - Decorative Metal Fences and Gates (A)

32 33 00 - Site Furnishings (L)

32 33 13 - Site Bicycle Racks (A)

32 91 13 - Soil Preparation (L)

32 93 00 - Plants (L)

32 94 00 - Landscape Grounds Maintenance for Ninety (90) Days (L)

DIVISION 33 - UTILITIES

NOT USED

DIVISION 34 - TRANSPORTATION

NOT USED

DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

NOT USED

DIVISION 40 - PROCESS INTEGRATION

NOT USED

DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT USED

DIVISION 42 - PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

NOT USED

DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

NOT USED

DIVISION 44 - POLLUTION CONTROL EQUIPMENT

NOT USED

DIVISION 45 - INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT USED

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

NOT USED

DIVISION 48 ELECTRICAL POWER GENERATION

NOT USED

END OF SECTION 00 01 10

PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

SECTION 00 31 00 - AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 00 31 00

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SECTION 00 40 13 - AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

STATE OF TEXAS

COUNTY OF _____

AFFIDAVIT

This Company, Contractor, or Subcontractor agrees to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and Regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

Company

Printed Name

Signature

STATE OF TEXAS

COUNTY OF _____

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Public: _____

State of _____

Commission expiration: _____

Seal

NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL
END OF SECTION 00 40 13

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PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

SECTION 00 40 14 - AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE

UPON COMPLETION OF THIS FORM, RETURN TO THE ARCHITECT AT PROJECT CLOSEOUT.

PROJECT:

Owner's Name: Alamo Colleges District - Northeast Lakeview College
Project Name: Northeast Lakeview College, Sundance Renovation
Project Address:
2049 Sundance Parkway.
New Braunfels, Texas 78130.

ARCHITECT:

PBK Architects, Inc.
601 NW Loop 410, Suite No. 400.
San Antonio, Texas 78216.
Architect's Project No. 250033.

CONTRACTOR:

Contractor: _____

Company Address:

Date: _____

AFFIDAVIT

Undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB-containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

Company

Printed Name

Signature

STATE OF TEXAS

COUNTY OF _____

Subscribed and sworn to before me this ____ day of _____, 20____.

Notary Public: _____

State of _____

Commission expiration: _____

Seal

PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

NOTE: THIS DOCUMENT MUST BE EXECUTED AND SUBMITTED AT PROJECT CLOSE-OUT
END OF SECTION 00 40 14

SECTION 00 40 17 - CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION REVIEW

GENERAL

CERTIFYING AFFIDAVIT SUBMITTED TO:

Owner: Alamo Colleges District - Northeast Lakeview College

Owner's Address:

1201 Kitty Hawk Rd.
Universal City, Texas 78148.

Project Name: Northeast Lakeview College, Sundance Renovation

Project Address:

2049 Sundance Parkway.
New Braunfels, Texas 78130.

The completion of Conflict of Interest Questionnaire is not needed if the person is an employee of a governmental entity and is acting in the employee's official capacity.

STATE OF TEXAS

COUNTY OF _____

(1) Undersigned representative, on behalf of the contracting firm identified below, swears and affirms to Alamo Colleges District - Northeast Lakeview College (the Owner) that such firm has obtained, reviewed and verified, from a law enforcement or criminal justice agency or a private entity that is consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681 et seq.) the criminal history record information of all employees hired **before January 1, 2008**, who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule A (the Contractor shall provide and attach hereto). Undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule A have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(2) Undersigned representative, on behalf of the contracting firm identified below, swears and affirms to the Owner, that such firm has obtained, reviewed and verified, from Texas Department of Public Safety criminal clearinghouse, the national criminal history record information of all employees hired **on or after January 1, 2008**, who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule B (the Contractor shall provide and attach hereto). Undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule B have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(3) Undersigned firm swears and covenants that no present or future employee will provide services to the Project that involve direct contact with students unless and until such employee's national criminal history record information has been reviewed and cleared as required by Paragraph (2) above, and an updated Certification has submitted by the contracting firm to the Owner with an updated Schedule B identifying such employees. In the event of an emergency, an employee who has not been previously certified may only provide services that involve direct contact with students if such employee is escorted by a representative of the Owner.

(4) Undersigned firm swears and covenants that, upon receipt of information, directly or indirectly, that any employee of the contracting firm has been convicted of an offense identified in Section 22.085 of the Texas Education Code, the contracting firm will immediately remove such employee from the Project and notify the Owner.

(5) Furthermore, if requested by the Owner, the name, driver's license number, and any other information required by the DPS will be submitted to Owner for any person on either Schedule A or Schedule B.

_____, being duly sworn, affirms and certifies that they are the _____ (position) of _____ (contracting firm), and that all statements and acknowledgements contained herein are true and correct, and that they have the authority to bind such firm to the covenants set out above.

Signature: _____

NOTARIZATION

Subscribed and sworn to before me this _____ day of _____, 20_____.

Notary Public: _____

State of _____

Commission expiration: _____

Seal

END OF SECTION 00 40 17

NON-COLLUSION DECLARATION

The undersigned declares:

I am the _____ [Title] of _____ [Name of Company], the party making the foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price, or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____ [Date] at _____ [City], _____ [State].

Signed: _

Printed Name: _

END OF SECTION 00 45 19

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SECTION 00 50 00 - TEXAS STATUTORY PERFORMANCE BOND

BOND NO.: _____

(PENALTY OF THIS BOND MUST BE 100% OF CONTRACT AMOUNT)

KNOW ALL MEN BY THESE PRESENTS, THAT:

that _____ (hereinafter called the Principal), as principal, and _____ a corporation organized and existing under the laws of the State of _____ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____ (hereinafter called the Obligee) in the amount of _____ U.S. Dollars (\$_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__, for

Name of Offeror (Contractor): _____

Project Name: Northeast Lakeview College, Sundance Renovation

Owner's Name: Alamo Colleges District - Northeast Lakeview College

Attn: Javier Dominguez

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH,

that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER,

that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF,

the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, 20__.

Principal: _____

Witness: _____

Witness: _____

Attorney-in-Fact: _____

Surety Address: _____

Surety City, State, ZIP: _____

Surety Telephone: _____

END OF SECTION 00 50 00

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SECTION 00 50 01 - TEXAS STATUTORY PAYMENT BOND

BOND NO.: _____

(PENALTY OF THIS BOND MUST BE 100% OF CONTRACT AMOUNT)

KNOW ALL MEN BY THESE PRESENTS,

that: _____ (hereinafter called the Principal), as principal, and _____ a corporation organized and existing under the laws of the State of _____ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____ (hereinafter called the Oblige) in the amount of _____ U.S. Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

the Principal has entered into a certain written contract with the Oblige, dated the _____ day of _____, 20__ for:

Name of Offeror (Contractor): _____

Project Name: Northeast Lakeview College, Sundance Renovation

Owner's Name: Alamo Colleges District - Northeast Lakeview College

Attn: Javier Dominguez

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH,

that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED,

that the bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and liabilities on this bond to claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF,

the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, 20__.

Principal: _____

Witness: _____

Witness: _____

Attorney-in-Fact: _____

Surety Address: _____

Surety City, State, ZIP: _____

Surety Telephone: _____

END OF SECTION 00 50 01

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SECTION 00 65 19.16 - AFFIDAVIT OF RELEASE OF LIENS FORM

GENERAL

SUMMARY

Document Includes: Applicability and use of statutory Waiver and Release of Lien forms promulgated by the Legislature of the State of Texas for construction projects in Texas.

STATUTORY REGULATIONS

Texas Property Code, Chapter 53, Subchapter L, Sections 53.281 through 53.287 (includes the standard forms attached herewith immediately following this section):

Form 1: Conditional Waiver and Release on Progress Payment.

Form 2: Unconditional Waiver and Release on Progress Payment.

Form 3: Conditional Waiver and Release on Final Payment.

Form 4: Unconditional Waiver and Release on Final Payment.

SELECTION AND USE OF WAIVER AND RELEASE OF LIENS FORM

Submit the applicable form, legally executed (filled out, signed, and dated) and notarized, for each occasion required. Refer to the Agreement and Section 01 29 00 - Payment Procedures.

The wording of these forms is prescribed by the State of Texas. Questions regarding the use, execution, etc. should be directed to user's own attorney experienced in construction or lien law. This document does not render legal advice.

If the Contract Documents do not explicitly require submittal of Waivers and Releases of Liens for each payment, Owner reserves the right, at its sole discretion, to require applicable Waivers and Releases of Liens, executed and notarized, for payment applications.

NOTE: The attached forms are duplicated verbatim (without editing) from Chapter 53 Property Code Sec. 53.284 (b), added by Acts 2011, 82nd Leg., R.S., Ch. 271 (H.B. [1456](#)), Sec. 3, effective January 1, 2012.

FORM 1: CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

PROJECT: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT'S PROJECT NUMBER: 250033

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of \$ _____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of Alamo Colleges District - Northeast Lakeview College (the Owner) located at (2049 Sundance Parkway, New Braunfels, Texas 78130 to the following extent:
_____(job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Signature: _____

Title: _____

FORM 2: UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

NOTICE:

This document waives rights unconditionally and states that you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

PROJECT: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT'S PROJECT NUMBER: 250033

The signer of this document has been paid and has received a progress payment in the sum of \$ _____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of Alamo Colleges District - Northeast Lakeview College (the Owner) located at 2049 Sundance Parkway, New Braunfels, Texas 78130 to the following extent:

_____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent: _____

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Signature: _____

Title: _____

FORM 3: CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

PROJECT: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT'S PROJECT NUMBER: 250033

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of \$ _____ payable to: _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of Alamo Colleges District - Northeast Lakeview College (the Owner) located at 2049 Sundance Parkway, New Braunfels, Texas 78130 to the following extent: _____ (job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____

Company Name: _____

Signature: _____

Title: _____

FORM 4: UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

NOTICE:

This document waives rights unconditionally and states you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

PROJECT: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT'S PROJECT NUMBER: 250033

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of Alamo Colleges District - Northeast Lakeview College (the Owner) located at 2049 Sundance Parkway, New Braunfels, Texas 78130 to the following extent: _____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____

Company Name: _____

Signature: _____

Title: _____

END OF SECTION 00 65 19.16

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SECTION 00 73 43 - WAGE RATE REQUIREMENTS (TEXAS)

GENERAL

REGULATIONS

The following information is from Chapter 2258 Texas Government Code:
Effective March 01, 2016.

2258.021. RIGHT TO BE PAID PREVAILING WAGE RATES.

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:

- (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
- (2) not less than the general prevailing rate of per diem wages for legal holidays and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

2258.023. PREVAILING WAGE RATES TO BE PAID BY CONTRACTOR AND SUBCONTRACTOR; PENALTY.

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.

(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.

(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.

(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.

(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

2258.051. DUTY OF PUBLIC BODY TO HEAR COMPLAINTS AND WITHHOLD PAYMENT.

A public body awarding a contract, and an agent or officer of the public body, shall:

- (1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
- (2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

WAGE RATES

Refer to Section 00 73 46 - Wage Determination Schedule for applicable Wage Rates.

END OF SECTION 00 73 43

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"General Decision Number: TX20250240 08/22/2025

Superseded General Decision Number: TX20240240

State: Texas

Construction Type: Building

County: Comal County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/03/2025
1	03/07/2025

2	03/14/2025
3	03/21/2025
4	06/13/2025
5	07/04/2025
6	08/01/2025
7	08/08/2025
8	08/22/2025

ASBE0087-014 06/03/2024

	Rates	Fringes

ASBESTOS WORKER/HEAT & FROST INSULATOR (Duct, Pipe and Mechanical System Insulation)....	\$ 29.50	8.79

BOIL0074-003 01/01/2025

	Rates	Fringes

BOILERMAKER.....	\$ 33.17	24.92

BRTX0005-006 06/01/2025

	Rates	Fringes

BRICKLAYER.....	\$ 25.50	8.12

ELEC0060-003 05/26/2025

	Rates	Fringes

ELECTRICIAN (Communication Technician Only).....	\$ 37.45	18%+5.45

ELEC0060-004 05/26/2025

	Rates	Fringes

ELECTRICIAN (Excludes Low Voltage Wiring).....	\$ 37.45	18%+5.45

ELEV0133-002 01/01/2025

	Rates	Fringes

ELEVATOR MECHANIC.....	\$ 51.59	38.435+a+b

Footnote:

A. 6% under 5 years based on regular hourly rate for all hours worked. 8% over 5 years based on regular hourly rate for all hours worked.

B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and Veterans Day.

ENGI0450-002 04/01/2024

	Rates	Fringes

POWER EQUIPMENT OPERATOR Cranes.....	\$ 39.47	10.39

IRON0084-011 06/01/2024

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 28.26	8.13

IRON0482-012 06/01/2025

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 28.30	8.23

PLUM0142-009 07/01/2024

	Rates	Fringes
HVAC MECHANIC (Electrical Temperature Control Installation & Unit Installation Only).....	\$ 36.87	11.48
PIPEFITTER (Including HVAC Pipe Installation).....	\$ 36.87	11.48
Including HVAC Pipe Installation PLUMBER.....	\$ 36.87	11.48
Excludes HVAC Pipe Installation		

* SFTX0669-002 04/01/2025

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 38.57	24.47

* SHEE0067-004 07/01/2025

	Rates	Fringes
Sheet metal worker Excludes HVAC Duct Installation.....	\$ 34.10	16.10
HVAC Duct Installation Only.	\$ 34.10	16.10

* SUTX2014-016 07/21/2014

	Rates	Fringes
CARPENTER (Acoustical Ceiling Installation Only).....	\$ 18.00	0.00
CARPENTER (Form Work Only).....	\$ 13.63 **	0.00
CARPENTER, Excludes Acoustical Ceiling Installation, Drywall Hanging, Form Work, and Metal Stud Installation.....	\$ 16.64 **	2.57
CAULKER.....	\$ 15.00 **	0.00
CEMENT MASON/CONCRETE FINISHER...	\$ 22.27	5.30
DRYWALL FINISHER/TAPER.....	\$ 13.81 **	0.00
DRYWALL HANGER AND METAL STUD INSTALLER.....	\$ 15.38 **	0.00

ELECTRICIAN (Low Voltage Wiring Only).....	\$ 20.19	3.75
IRONWORKER, REINFORCING.....	\$ 12.27 **	0.00
LABORER: Common or General.....	\$ 14.11 **	0.00
LABORER: Mason Tender - Brick...	\$ 12.00 **	0.00
LABORER: Mason Tender - Cement/Concrete.....	\$ 12.00 **	0.00
LABORER: Pipelayer.....	\$ 11.00 **	0.00
LABORER: Roof Tearoff.....	\$ 11.28 **	0.00
LABORER: Landscape and Irrigation.....	\$ 8.00 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 19.43	3.49
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 14.00 **	0.00
OPERATOR: Bulldozer.....	\$ 14.00 **	0.00
OPERATOR: Drill.....	\$ 14.50 **	0.00
OPERATOR: Forklift.....	\$ 13.06 **	0.00
OPERATOR: Grader/Blade.....	\$ 19.30	0.00
OPERATOR: Loader.....	\$ 13.90 **	0.00
OPERATOR: Mechanic.....	\$ 18.75	5.12
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 16.03 **	0.00
OPERATOR: Roller.....	\$ 11.25 **	0.00
PAINTER (Brush, Roller and Spray), Excludes Drywall Finishing/Taping.....	\$ 13.13 **	0.00
ROOFER.....	\$ 12.00 **	0.00
TILE FINISHER.....	\$ 11.32 **	0.00
TILE SETTER.....	\$ 16.91 **	0.71
TRUCK DRIVER: Dump Truck.....	\$ 12.39 **	1.18
TRUCK DRIVER: Flatbed Truck.....	\$ 19.65	8.57
TRUCK DRIVER: Semi-Trailer Truck.....	\$ 12.50 **	0.00
TRUCK DRIVER: Water Truck.....	\$ 12.00 **	4.11

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates

in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE:

UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination

- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

=====

END OF GENERAL DECISION"

SECTION 01 23 00 - ALTERNATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Description of Alternates.
 - 2. Procedures for pricing Alternates.
 - 3. Documentation of changes to Contract Price and Contract Time.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Alternate

1.4 ADMINISTRATIVE REQUIREMENTS

- A. The Alternates listed in this Section take precedence over those listed elsewhere in the Contract Documents. In case of conflicting requirements, the requirements listed herein shall govern.

1.5 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

1.6 SCHEDULE OF ALTERNATES

- A. Alternate No. 01: Front Entry:
 - 1. Base Bid Item: Demolish front entry storefront system with revolving doors. Canopy and concrete paving to remain unchanged.
 - 2. Alternate Item: Remodel front entry including addition of higher facade, canopy, concrete paving, and landscape as shown in drawings.
- B. Alternate No. 02: Paint Building Exterior:
 - 1. Base Bid Item: Exterior building paint to remain unchanged.
 - 2. Alternate Item: Paint all building exterior facades.
- C. Alternate No. 03: Building Envelope Deferred Maintenance Scope:
 - 1. Base Bid Item: Building envelope and roof to remain unchanged.
 - 2. Alternate Item: Repair/replace building sealants, roof sealants, spalling concrete, tilt-wall penetrations, door weather stripping components, and site sealant as shown in drawings. Provide overflow scuppers as shown in the drawings.
- D. Alternate No. 04: Ceiling Heights:
 - 1. Base Bid Item: Existing ceiling heights to remain.
 - 2. Alternate Item: Change ceiling heights.
- E. Alternate No. 05: Area C (Engineering Wing):
 - 1. Base Bid Item: Area C (Engineering Wing) to be built out as shown in drawings
 - 2. Alternate Item: Area C (Engineering Wing) to be shell space.
- F. Alternate No. 06: Area A, B & C (Early Completion):
 - 1. Base Bid Item: Provide substantial completion by September 4, 2026.
 - 2. Alternate Item: Provide substantial completion by July 24, 2026 (Early Completion).
 - a. Alternate No. 06.01 – Front Entry (Early Completion):

- b. Alternate No. 06.02 – Paint Building Exterior (Early Completion):
- c. Alternate No. 06.03 – Building Envelope Deferred Maintenance Scope (Early Completion):
- d. Alternate No. 06.04 – Ceiling Heights (Early Completion):
- e. Alternate No. 06.05. – Area C (Engineering Wing) to be Shell Space (Early Completion):

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 01 23 00

SECTION 01 25 13.01 - REQUEST FOR SUBSTITUTION FORM

PROJECT INFORMATION

PROJECT NAME AND NUMBER: _____

CONTRACT AWARD DATE: _____

TO: _____

SUBSTITUTION REQUESTED BY: _____

REQUEST MADE DURING:

_____ Bidding

_____ Construction Period

CAUSE FOR REQUEST: _____

SUBSTITUTION INFORMATION

SUBMIT IN ACCORDANCE WITH SECTION 01 33 00 - SUBMITTAL PROCEDURES.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

BASIS OF DESIGN

Specified Manufacturer: _____

Specified Product: _____

Where Specified:

Drawing (Sheet Number and Detail/Schedule): _____

Specification: (Section Number and Paragraph): _____

PROPOSED SUBSTITUTION

We submit for consideration the following manufacturer / product in lieu of the specified item for the above referenced project:

Proposed Manufacturer: _____

Proposed Product: _____

COST AND TIME

Does proposed substitution affect adjacent work, Construction Documents, Cost, Schedule, Quality, or related submittals?

_____ No

_____ Yes

The Contractor is responsible for costs and additional time associated with proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by requested substitution.

Cost Savings Realized by the Owner (\$ US):

WARRANTY

Is warranty for proposed substitution the same as for specified product?

_____ Yes

_____ No

If No, Explain Differences: _____

CONTRACTOR CERTIFICATION:

In making this request for substitution, the Contractor certifies that:

1. Proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. Proposed substitution will provide the same or better warranty at no additional cost to the Owner.
3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
4. The Contractor shall assume responsibility for delays and costs caused by acceptance proposed substitution, if approved, are accepted by the Contractor unless delays and costs are specifically mentioned and approved in writing by Owner and Architect.
5. The Contractor shall assume liability for performance of the substitution.
6. Installation of the proposed substitution is coordinated with the Work and with changes required to the Work.
7. The Contractor shall reimburse the Owner and the Architect for evaluation and redesign services associated with the substitution request and, when required, for approval by authorities having jurisdiction.

PREVIOUS USE

Has the proposed substitute manufacturer / product been installed on previous PBK Architects, Inc. projects within the past two years?

_____ No

_____ Yes

If Yes, list project(s):

Project: _____

Owner: _____

Contact: _____

Project: _____

Owner: _____

Contact: _____

SUBMITTED BY:

Contractor's Signature: _____

Signature shall be by the individual authorized to legally bind the Contractor to the above terms. Failure to provide legally binding signature will result in retraction of acceptance.

Firm: _____

Telephone: _____ Date: _____

SUBSTITUTION EVALUATION

FOR USE BY ARCHITECT:

___ Accepted ___ Accepted as Noted ___ Not Accepted ___ Received too Late

PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

By: _____ Date: _____

Remarks: _____

FOR USE BY OWNER:

____ Accepted ____ Not Accepted

By: _____ Date: _____

Remarks: _____

END OF SECTION 01 25 13.01

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Work:
 - 1. Section 01 25 13 - Product Substitution Procedures

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner Initiated Proposal Requests: The Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by the Architect are not instructions either to stop Work in progress or to execute the proposed change.
 - 2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. The Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Architect.
 - 1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 13 - Product Substitution Procedures if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document AIA G709.
- C. The Contractor has 10 business days to submit pricing or submit resubmittal pricing to the Architect after issuance of a Change Proposal Request (CPR) or Change Proposal.
- D. Regardless of initiated change request pricing, a fully developed and completed change pricing to be submitted.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 - Allowances for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
 1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - a. Include installation costs in purchase amount only where indicated as part of the allowance.
 - b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
 - d. The Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
 2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or the Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. The Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

- A. On the Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of the Owner and the Contractor on AIA Document AIA G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: The Architect may issue a Construction Change Directive on AIA Document AIA G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Schedule of Values.
 - 2. Pencil Copy.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of the Contractor's construction schedule.
 - 1. Coordinate line items in Schedule of Values with administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Updated Submittal schedule.
 - c. Items required to be indicated as separate activities in updated the Contractor's construction schedule.
 - 2. Submit Schedule of Values to the Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Application for Payment. The Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA G703.
 - 3. Arrange Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment Rentals.
 - 4) General Conditions.

- (a) Supervisor.
 - (b) Submittals.
 - (c) Close-out.
 - (d) Field Engineering.
 - (e) Daily Clean-up.
 - (f) Final Clean-up.
- 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.
- 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Submit preliminary (pencil) copy of proposed values to the Architect or the Architect's field representative and the Owner for review by 20th day of the month. Allow 48 hours for comments.
- B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for AIA G702 or other similar form approved by the Owner.
 - 1. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
 - 2. Submit updated construction or recovery schedule with each Application for Payment.
- C. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Section 00 73 00 - Supplementary Conditions.
- D. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.
- E. Substantiating Data: When the Architect requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
 - 1. Current Record Documents as specified in Section 01 77 00 - Closeout Procedures maintained.
 - 2. Labor time sheets, purchase orders, or similar documentation.
 - 3. Affidavits attesting to off-site stored products.

PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 01 29 00

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Experienced.
 - 2. Installer/Applicator/Erector.
 - 3. Mockups.
 - a. Laboratory Mockups.
 - b. Integrated Exterior Mockups.
 - c. Room Mockups.
 - 4. Quality Assurance Services.
 - 5. Quality Control Services.
 - 6. Testing:
 - a. Field Quality Control Testing.
 - b. Preconstruction Testing.
 - c. Product Testing.
 - d. Source Quality Control Testing.
 - 7. Testing Agency.
- B. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits.

To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Statement of Responsibility: When required by Authorities Having Jurisdiction (AHJ), submit copy of written statement of responsibility sent to Authorities Having Jurisdiction (AHJ) authorities having jurisdiction before starting Work on the following systems:
 - 1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
 - 2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspect.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow seven days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8 ft by 8 ft. Mockup shall include all major façade elements and at least one window minimum 2 ft by 2 ft in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.
- M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner shall engage a qualified testing agency to perform the services.
 - 1. Owner shall furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 31 00 - Project Management and Coordination.
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.

- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner shall engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
 - 1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected Work.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.

- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29 - Cutting and Patching.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

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SECTION 01 41 00 - REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Related Sections:
 - 1. Section 01 40 00 - Quality Requirements.

1.3 REFERENCE STANDARDS

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Includes Supplements 1 and 2; 2022.
- D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ICC (IFGC) - International Fuel Gas Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- H. NFPA 1 - Fire Code; 2024, with Errata.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- K. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).
- L. Refer to individual Sections for additional Reference Standards applicable to the scope of work defined by that Section..

1.4 QUALITY ASSURANCE

- A. Contractor's Designer Qualifications: Refer to Section 01 40 00 - Quality Requirements.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Requirements:
 - a. Perform all work on this Project in strict accordance with, but not limited to, applicable requirements and portions of the latest adopted editions of the currently adopted codes, revisions, amendments, supplements, and their references.
 - 1) Building Codes:
 - (a) International Building Code ICC (IBC).
 - (b) International Fuel Gas Code ICC (IFGC).
 - (c) International Plumbing Code ICC (IPC).
 - (d) National Electric Code (NFPA 70).
 - b. Miscellaneous NFPA;

- c. Accessibility:
 - 1) Texas Accessibility Standard (2012 TAS).
 - 2) U.S. Department of Justice, ADA Standards - 2010 ADA Standards for Accessible Design.
 - 3) U.S. Department of Justice Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 4) ICC A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- d. Other:
 - 1) American Society of Civil Engineers - ASCE 7:
 - 2) Minimum Design Loads for Buildings and Other Structures.
 - 3) Demolition: Comply with NFPA 1 - Chapter 29 and NFPA 241 - Standard for Safeguarding Construction Alteration and Demolition Operation Latest Adopted Edition.
- 2. Code Standards:
 - a. All work shall conform to applicable portions of the adopted, or the latest edition of the standards listed, which shall include, but is not limited to, the following:
 - 1) Aluminum Association (AA).
 - 2) American Concrete Institute (ACI).
 - 3) American Institute of Steel Construction (AISC).
 - 4) American National Standards Institute (ANSI).
 - 5) American Society for Testing and Materials (ASTM).
 - 6) American Society of Mechanical Engineers (ASME).
 - 7) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - 8) American Welding Society (AWS).
 - 9) Architectural Woodworking Institute (AWI).
 - 10) Architectural Aluminum Manufacturer's Association (AAMA).
 - 11) Commercial Standards (CS).
 - 12) Federal Specifications and Standards (FSS).
 - 13) National Safety and Health Administration (OSHA).
 - 14) National Institute for Standards and Technology (NIST).
 - 15) Architectural Sheet Metal Manual (SMACNA).
 - 16) Underwriter's Laboratories (UL).
 - 17) U.S. of America Standards Institute (ASI).
 - 18) U.S. Department of Commerce Product Standards (USDCPS).
- 3. Code Discrepancies:
 - a. In case of discrepancy between the codes, standards, and specifications listed, the strictest or most stringent requirement shall govern.
- 4. Compliance with Codes:
 - a. A permit issued will be construed as permission to proceed with construction, and not as authority to violate, cancel, alter, or set aside any of the provisions of any Codes.
 - b. Nor shall issuance of a permit prevent the Owner from thereafter requiring a correction of errors in plans, construction, or violations of any Codes.

PART 3 EXECUTION

END OF SECTION 01 41 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. Section Includes: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
 - 1. Water service and distribution.
 - 2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
 - 3. Heating and cooling facilities.
 - 4. Ventilation.
 - 5. Electric power service.
 - 6. Lighting.
 - 7. Waste disposal facilities.
 - 8. Storage and fabrication sheds.
 - 9. Lifts and hoists.
 - 10. Construction aids and miscellaneous services and facilities.
 - 11. Environmental protection.
 - 12. Pest control.
 - 13. Site enclosure fence.
 - 14. Security enclosure and lockup.
 - 15. Barricades, warning signs, and lights.
 - 16. Temporary partitions.
 - 17. Fire protection.
 - 18. Accessories necessary for a complete installation.

1.3 USE CHARGES

- A. Installation and removal of, and use charges for, temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility connections, staging areas, and construction personnel parking areas.
- B. Moisture Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
 - 3. Indicate sequencing of Work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

- C. Dust and HVAC Control Plan: Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessible Temporary Egress: Comply with applicable provisions in ADA Standards, ICC A117.1-2009, and 2012 Texas Accessibility Standards (2012 TAS).
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70-2017.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for intended use.
- B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E84.
- D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).
- E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.
- F. Lumber and Plywood: Comply with requirements in Section 06 10 00 - Rough Carpentry.
- G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 21 16 - Gypsum Board Assemblies.
- H. Paint: Comply with requirements in Section 09 90 00 - Painting and Coating.
- I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.
- J. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

- B. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).
- C. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125V AC, 20 A rating, and lighting circuits may be non-metallic sheathed cable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 - Summary.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 - 2. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.

1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 - a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
 - b. Provide warning signs at power outlets other than 110 to 120V.
 - c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
 - d. Provide metal conduit enclosures or boxes for wiring devices.
 - e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125V AC, 20A circuit for each outlet.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines shall be of non-combustible construction according to ASTM E136. Comply with NFPA 241.
 1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00 - Earth Moving.
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
- F. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 - Execution.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Use of Permanent Elevators: Use of new elevators for construction traffic will be permitted, provided elevators are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
 2. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates.
 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.
 3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed, dustproof doors and security locks where openings are required.
 6. Protect air handling equipment.
 7. Provide walk off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.

5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Condition Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 - Closeout Procedures.

END OF SECTION 01 50 00

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SECTION 01 55 00 - VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access roads.
 - 2. Parking.
 - 3. Construction parking controls.
 - 4. Haul routes.
 - 5. Traffic signs and signals.
 - 6. Maintenance.
 - 7. Removal, repair.
- B. Related Sections:
 - 1. Section 01 10 00 - Summary: For access to site, work sequence, and occupancy.
 - 2. Section 01 50 00 - Temporary Facilities and Controls: Post Mounted and Wall Mounted Traffic Control and Informational Signs.
 - 3. Section 31 22 00 - Grading: Specifications for earthwork and paving bases.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Temporary Construction: Contractor's option.
- B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

PART 3 EXECUTION

3.1 ACCESS ROADS

- A. Use of designated, existing, on-site streets and driveways for construction traffic is permitted.
- B. Tracked vehicles not allowed on paved areas.
- C. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.
- D. Provide and maintain access to fire hydrants free of obstructions.

3.2 PARKING

- A. When site space is not adequate, arrange for additional off-site parking.

3.3 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owner's operations.
- B. Monitor parking of construction personnel's vehicles. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.4 HAUL ROUTES

- A. Confine construction traffic to designated haul routes.
- B. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

- B. Relocate as work progresses, to maintain effective traffic control.

3.6 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.7 REMOVAL, REPAIR

- A. Repair existing and new permanent facilities damaged by use, to original condition.
- B. Remove equipment and devices when no longer required.
- C. Repair damage caused by installation.
- D. Remove post settings to a depth of 2 feet (600 mm).

END OF SECTION 01 55 00

SECTION 01 56 00 - TEMPORARY BARRIERS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Temporary jobsite protection including the following:
 - 1. Temporary floor and wall protection.
 - 2. Door jamb protection.
 - 3. Small project floor and wall protection.
 - 4. Seaming tape for floor protection.
 - 5. Recyclable, portable jobsite trash containers.

1.3 RELATED SECTIONS

- A. Section 03 30 00 "Cast-In-Place Concrete".
- B. Division 08 Openings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum Five (5) years' experience manufacturing similar products.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handle materials to avoid damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Ram Board.
 - 2. Surface Shields.
 - 3. Trimaco, Inc.

2.2 TEMPORARY FLOOR AND WALL PROTECTION

- A. Temporary protection board shall comply with the following requirements, as necessary for the use.
 - 1. Materials:
 - 2. Fold lines allowing corner, horizontal and vertical wall protection.
 - a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.
 - 3. Allow protected substrates and finishes to cure while being protected.

4. Protection against water, paint, mud, and more.
- B. Basis of Design:
 1. Products as manufactured by Ram Board.
 - a. Heavy Duty Temporary and Reusable Floor and Wall Protection: Ram Board Model #RB 38-100.
 - b. Pre-Taped Board: Ram Board Plus Model #RB PLUS 38-100.
 - c. Reusable Protection for Small Projects: Ram Board Home Edition Model #RBHE 36-50.
 - d. Painter's Board: Ram Board Painter's Board Model #20RB 35-50.

2.3 DOOR JAMB PROTECTION

- A. Door Jamb Protection: Heavy-duty flexible re-usable door jamb protection.
 1. Materials: Recycled and recyclable materials.
 2. Door Jamb Sizes: Fits 4 inches – 9 inches (102 mm – 229 mm).
 3. Basis of Design: Model # RBJP 60 or RBJP 36 Ram Jamb.

2.4 SEAMING AND EDGE TAPES FOR FLOOR PROTECTION

- A. Seaming Tape: Used to cover Ram Board seams.
 1. Backing: Unique kraft backing tears easily and creates an extremely durable, smooth finish.
 2. Basis of Design: Ram Board Model #RT 3-164.
- B. Vapor-Cure Tape: Used to cover Ram Board seams which prevents tape lines.
 1. Performance: Allows vapors and moisture to escape from concrete, glue down floors, stained floors, epoxy floors, refinished floors, vinyl composition tile, and most other floor types.
 2. Basis of Design: Ram Board Model #RB VCT 3-108
- C. Edge Tape: Used to secure Ram Board Temporary Floor Protection edges to flooring or wall surfaces.
 1. Performance: Easy Release, low tack tape for up to 14 days. Grips tightly to Ram Board while easy release on flooring surfaces up to 14 days.
 2. Basis of Design: Ram Board Model #RB ET 2.5-180.

2.5 PORTABLE JOBSITE TRASH CONTAINERS

- A. Portable Jobsite Trash Containers: Portable, reusable jobsite trash container.
 1. Fits Trash Bags: 42 gal – 50 gal (159 to 189 L).
 2. Quick self-locking assembly, no tape required.
 3. Basis of Design: Ram Board Trash Box Model # RBTB 16-36.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation. Proceed with installation or protection products only after unsatisfactory conditions have been corrected.
- B. Do not begin protection 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 INSTALLATION

- A. Install protection products in accordance with manufacture's written instructions and approved submittals.

3.3 PROTECTION

- A. Protection installed products may be left in place until completion of project or adjacent work.

END OF SECTION 01 56 00

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SECTION 01 56 39 - TREE PRUNING, FERTILIZING AND PROTECTION

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS:** The Drawings, Division 0 and Division 1 apply to the Work in this Section.
- 1.2 DESCRIPTION OF THE WORK:**
- A. Work Included:
 - Protecting of existing trees (Refer also to the drawings).
 - Protecting of existing utilities.
 - Protection fencing and planking
- 1.3 GENERAL PROVISIONS:**
- A. Trees and areas scheduled for work under this contract shall be identified in the field and indicated on plans and specifications where practical. Where this is not practical, work shall be directed in field by Owner's Representative.
 - B. Provision for access to the site for heavy equipment will be as directed by Owner's Representative. Equipment shall use prescribed temporary roadways and shall not be allowed in areas other than designated construction areas and designated roadways. Open grass areas which are altered or disturbed by equipment during the work shall be returned to pre-existing conditions at no additional cost to Owner.
 - C. Contractor shall protect root areas and crowns of trees from damage from construction operations and construction equipment. The Contractor shall repair such damage at no costs to Owner. Provide fences or other barricade where necessary for such protection.
 - D. Contractor shall modify exhaust pipes on construction equipment as needed to ensure that tree crowns are not damaged from exhaust heat from vertical exhaust pipes on top of construction equipment.
 - E. Equipment shall not contact tree trunks, limbs or foliage.
 - F. Contractor shall be responsible for providing all tree work/repair to any damage to existing trees during the contract period. Damage to any existing trees shall be reported immediately to the Owner's Representative. Contractor shall submit to Owner's Representative a written program of corrective pruning and tree care to repair damage with name of qualified forester or arboriculturist for Owner's approval.
- 1.4 REFERENCE STANDARDS:**
American National Standard for Tree Care Operations Arisi-A-300 Tree shrub and other woody plant maintenance-standard practices, 1995.
- 1.5 SUBMITTALS:**
Furnish required copies of manufacturers literature, samples, certifications, or laboratory analytical data for the following items:
Tree paint (manufacturer's literature)
- A. Urban forester or Arborist. (Resume with education, experience, and credentials)
 - B. Soil separator (manufacturer's literature and sample). For vapor barrier 10 mil visquene
 - C. Gravel (one cubic foot)
 - D. Mulch: Decomposed hardwood mulch: submit 1 cubic foot sample.
 - E. Fertilizer: submit product data.

PART 2 – PRODUCTS

- 2.1 TRENCHING MACHINE:** Shall be small non-riding track type trencher equal to Case 300.

- 2.2 SHARP SAND:** ASTM C-33 for fine aggregate.
- 2.3 TREE PROTECTION FENCE POSTS:** 7' long metal t-posts.
- 2.4 TREE PAINT:** Thompson Tree Seal, Cabot Tree Paint or approved equal.
- 2.5 PRUNING TOOLS:** Shall be of good quality and working condition, sharp, and of the approved type for arboricultural work.
- 2.6 WOOD FOR TREE PROTECTION PLANKING:** Shall be construction grade Southern Yellow Pine.
 - A. Wood for planking: two (2") x four (4")
- 2.7 FENCING:** shall be orange plastic fencing 4' tall.
- 2.8 INSECTICIDE:** Shall be Ortho "Lindane Borer and Leaf Miner Spray" by Ortho Consumer Products Division, Chevron Chemical Company, San Francisco, California 94119 or approved equal.
- 2.9 FERTILIZER:** Arbor Green 30-10-7
- 2.10 WATER:** Suitable for irrigation.

PART 3 – EXECUTION

- 3.1 WORKMANSHIP:**
 - A. Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a qualified forester or arborist on Contractor's staff. Owner shall review and approve Contractor's program for repair to damaged trees prior to the work being done.
 - B. Work shall be performed in conformance with recognized horticultural and arboricultural practices. Where job requirements require deviation from normal practice, obtain approval.
- 3.2 LIMB PRUNING:** ANSI-A-300 1995
- 3.3 MAINTENANCE PRUNING:** Maintenance pruning is to maintain or improve tree health and structure and shall consist of the following: limited to branches measuring one (1") inch and larger.
 - A. Crown cleaning: Crown cleaning shall consist of the removal of the following items: dead, dying, diseased, weak branches from a tree's crown. Remove waterspouts from trunks and major limbs clearing up to a maximum distance of only six (6) feet to eight (8) feet from main trunk.
 - B. Crown thinning: Crown thinning shall consist of the selective removal of branches to increase light penetration, air movement, and reduce weight.
 - C. Crown raising: Crown raising shall consist of the removal of the lower branches of a tree in order to provide clearance. Clearance to be determined by Owner's representative.
 - D. All trees designated to remain and to be protected shall be pruned per ANSI-A-300 1995 standards.
 - 1. All cuts shall be made as close as possible to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub. Bark at the edge of all pruning cuts should remain firmly attached.

2. All branches too large to support with one hand shall be precut to avoid splitting or tearing of the bark. Where necessary, ropes or other equipment should be used to lower large branches or stubs into the ground.
3. Trimming shall not alter the natural appearance or result in leaving a hole in the canopy.
4. Paint wounds on Oak trees with approved paint.
5. Old injuries are to be inspected. Those not closing properly and where the callus growth is not already completely established should be bark traced if the bark appears loose or damaged. Such tracing shall not penetrate xylem (sapwood), and margins shall be kept rounded.
6. Equipment that will damage the bark and cambium layer should not be used on or in the tree. For example, the use of climbing spurs (hooks, irons) is not an acceptable work practice for pruning operations on live trees. Sharp tools shall be used so that clean cuts will be made at all times.
7. All cut limbs shall be removed from the crown upon completion of the pruning.
8. Trees susceptible to serious infectious diseases should not be pruned at the time of year during which the pathogens causing the diseases, or the insect vectors are most active. Similarly, if pruning wounds may attract harmful insects, pruning should be timed so as to avoid insect infestation.
9. Remove the weaker or less desirable of crossed or rubbing branches. Such removal, if possible, should not leave large open spaces in the general outline of the tree.
10. Where practical, all visible girdling roots shall be treated as follow: (1)Cut root at either end; or (2)Sever root in center with a chisel and allow growing tree to push root away; (3) Remove section of root.
11. The presence of any disease condition, fungus fruit bodies, decayed trunk or branches, split crotches or branches, cracks, or other structural weaknesses shall be reported in writing to a supervisor and/or the owner, and corrective measures recommended.

3.4 ROOT PRUNING: (in areas where roots cannot be preserved by hand digging)

- A. Root pruning shall be installed at the back of new curb for the parking lot excavation where the excavation for the lot lowers the grade below the existing grade within the drip line of the existing trees and in areas where soils will be lime stabilized.
- B. Root prune at edge of proposed excavation or lime stabilization only in areas where roots cannot be preserved.
- C. Root pruning by trenching shall be as required; twenty-four (24") inches deep and six (6") inches wide, or ten inches (10") below limits of proposed excavation, lime stabilization or soil disturbance, whichever is less.
- D. Trenching shall be performed by the approved trencher cutting any and all roots completely and cleanly. Tearing, shredding or pulling of the roots shall not be permitted. After trenching with machine, re-cut roots with pruning shears or saw to leave a smooth cut surface.
- E. Air-spade tools to be used where root pruning by hand is not feasible; contractor to protect critical root zones.
- F. Install 10 mil visquene in root prune trench to create non-leach barrier between soil stabilizer material and root zone.
- G. Fill trench to existing finished grade in a manner that will not allow soils to settle.
- H. Cover exposed roots within 24 hours using bank sand topsoil or mulch to prevent desiccation.

3.5 FENCES AND BARRICADES:

- A. Fences and/or barricades shall be installed prior to the commencement of any site preparation work (cleaning, grubbing or grading) placed where shown on the drawings or

as herein described. Tree fencing shall be maintained throughout the construction project in order to prevent the following:

1. Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment and/or equipment and/or materials.
 2. Root zone disturbances due to grade changes (greater than 3" inches cut or fill), and /or trenching not reviewed or authorized by the Owner's representative.
 3. Wounds to exposed roots, trunks, or limbs by mechanical equipment.
 4. Other activities detrimental to trees such as: chemical storage, cement truck wash-out and fires.
- B. In general, fences and barricades are intended to alert those working on the project that equipment and machinery are not to be stored or operated in the root zone. Where not shown, the fences shall be placed at the drip line. The exact location of fences shall be marked on site by Contractor and approved by Owner's Representative prior to construction of barricades.
- C. Posts shall be installed eight (8") feet O.C. maximum, one and one half (1 1/2') feet deep. Fence material pulled taut and secured with galvanized wire.

3.6 TREE PLANKING:

- A. Where exceptions result in temporary fence being closer than four feet to a tree trunk, protect trunk with strapped-on wood planking to a vertical height of 8 feet (or to the limits of the lower branches).
- B. Place two x fours with sides touching completely around the circumference of the tree. Secure at three points; top, middle and bottom with galvanized wire; twisted taut and stapled to wood planking.

3.7 TREE PROTECTION:

- A. All trees to be preserved on the property shall be protected against damage during construction operations by fencing as shown; subject to the approval of the Owner's Representative. The tree protection shall be installed prior to commencement of any site preparation work (clearing, grubbing or grading) and maintained in repair for the duration of the construction work unless otherwise directed. No material shall be stored or construction operation shall be carried on within a distance as shown of any tree to be saved or within the tree protection fencing. Tree protection shall remain until all work is completed.
1. Place 6" of mulch to completely cover the area underneath the drip line of the trees in areas where foot traffic cannot be avoided.
 2. Trees shall be watered once a week during periods of hot dry weather as directed by Owner's representative to thoroughly saturate soil.
 3. All grading within protected root zone areas shall be by hand or small equipment to prevent root damage resulting from soil compaction and rutting. Prior to grading relocate protective fencing to two feet behind grade change area.
- B. Any damage done to existing tree crowns or root systems shall be repaired immediately by an approved tree surgeon at the Owner's direction. Roots exposed and/or damaged during demolition and/or grading operations shall be cut off cleanly inside the exposed or damaged area, the cut surfaces painted with an approved tree paint, and the topsoil and mulch placed over the exposed root area immediately. The Owner shall have his representative present on the site to observe these operations.

3.8 CONSTRUCTION EQUIPMENT:

- A. Contractor shall modify construction equipment as necessary to ensure that exhaust systems do not burn or scorch tree crowns or branches. Vertical exhaust pipes shall be turned 90 degrees.
- B. Height of equipment and equipment operation heights shall be carefully monitored to ensure no damage to tree crowns or branching.

- 3.9 BORER PROTECTION:** Immediately after tree protection is complete, apply specified insecticide at the rate prescribed by the manufacturer's instructions.
- 3.10 APPLICATION OF TREE FERTILIZER:** Arbor Green 30-10-7 mixed and applied per product label instruction for 40 pounds of Arbor Green mixed in 100 gallons of water. Fertilizer shall be added to tank and mixed on site. Owner's representative shall be notified 24 hours prior to applying fertilizer.
- 3.11 ADDITIONAL PROVISIONS:**
- A. No trash or warming fires shall be placed within twenty five (25') feet of the tree canopy.
 - B. No pedestrian traffic shall occur within the drip line of any tree without proper protection measures in place.
 - C. No soil shall be spread, under any tree within the drip line, unless otherwise designated or approved by owner's representative.
 - D. Hand dig to preserve roots measuring one inch (1") in diameter and larger, roots shall not be scuffed or damaged otherwise.

END OF SECTION 01 56 39

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for selection of products, including but not limited to:
 - 1. Product delivery, storage, and handling.
 - 2. Product warranties.
 - 3. Comparable products.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Basis of Design Product Specification.
 - 2. Product.
 - a. Comparable Product.
 - b. Named Products.
 - c. New Products.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the specified requirements.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect shall notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 - Submittal Procedures.
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis of Design Product Specification Submittal: Comply with requirements in Section 01 33 00 - Submittal Procedures. Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each Contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 2. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected", Architect shall make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 13 - Product Substitution Procedures for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "selected by Architect" or similar phrase, select a product that complies with requirements. Architect shall select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect shall consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PBK Architects, Inc.
PBK Project No. 250033
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

PART 3 EXECUTION
NOT USED

END OF SECTION 01 60 00

SECTION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Requirement for installer certification that they did not use any non-compliant products.
- B. Related Requirements:
 - 1. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.

1.3 INCLUDED PRODUCTS

- A. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:

1.4 REFERENCE STANDARDS

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

1.6 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
 - 1. Wet-Applied Products: State amount applied in mass per surface area.
 - 2. Paints and Coatings: Test tinted products, not just tinting bases.
 - 3. Evidence of Compliance: Acceptable types of evidence are the following:
 - a. Current UL (GGG) certification.
 - b. Current SCS (CPD) Floorscore certification.
 - c. Current SCS (CPD) Indoor Advantage Gold certification.
 - d. Current listing in CHPS (HPPD) as a low-emitting product.
 - e. Current CRI (GLP) certification.
 - f. Test report showing compliance and stating exposure scenario used.
 - 4. Product data submittal showing VOC content is NOT acceptable evidence.
 - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
 - b. Published product data showing compliance with requirements.
 - c. Certification by manufacturer that product complies with requirements.

- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scs-certified.com.
 - b. Report of laboratory testing performed in accordance with requirements.
 - c. Published product data showing compliance with requirements.
 - d. Certification by manufacturer that product complies with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
 - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to the Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by the Contractor.

END OF SECTION 01 61 16

SECTION 01 73 00 - EXECUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Coordination of Owner-installed products.
 - 4. Progress cleaning.
 - 5. Protection of installed construction.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Cutting.
 - 2. Patching.

1.4 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
 2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with Authorities Having Jurisdiction (AHJ).
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 - Project Management and Coordination.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, promptly notify Architect.
- B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
 2. Establish limits on use of site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.

5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by Authorities Having Jurisdiction (AHJ).
- C. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.5 OWNER-INSTALLED PRODUCTS

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

- B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's Work. Attend pre-installation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

- A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 - Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion. Refer to Section 01 56 00 - Temporary Barriers and Enclosures.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

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SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Procedural requirements for cutting and patching.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Cutting.
 - 2. Patching.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Structural Elements: When cutting and patching structural elements, notify the Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
- C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Fire separation assemblies.
 - 3. Air or smoke barriers.
 - 4. Fire suppression systems.
 - 5. Mechanical systems piping and ducts.
 - 6. Control systems.
 - 7. Communication systems.
 - 8. Fire detection and alarm systems.
 - 9. Conveying systems.

10. Electrical wiring systems.
 11. Operating systems of special construction.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise and vibration control elements and systems.
 7. Sprayed fire resistive material.
- E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
- F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Comply with specified requirements.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.
 - 2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 - Summary.
- E. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish,

- color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Disposing of non-hazardous waste.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Construction Waste.
 - 2. Demolition Waste.
 - 3. Disposal.
 - 4. Recycle.
 - 5. Salvage.
 - 6. Salvage and Reuse.

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within 10 days of date established for commencement of the work.
- B. Waste Reduction Progress Reports:
 - 1. Concurrent with each Application for Payment, submit report.
 - a. Use Form CWM-8 for demolition waste.
 - 2. Include the following information:
 - a. Material category.
 - b. Generation point of waste.
 - c. Total quantity of waste in tons (tonnes).
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end of Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Firm having minimum 10 years documented experience in specializing in waste management coordination.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference:
 - 1. Conduct conference at site. Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

- d. Review procedures for periodic waste collection and transportation to disposal facilities.
- e. Review waste management requirements for each trade.

1.6 PERFORMANCE REQUIREMENTS

- A. Conform to applicable regulations regarding Solid Waste Control.
- B. Practice efficient waste management in the use of materials in the course of the Work.

1.7 WASTE MANAGEMENT PLAN

- A. Develop a waste management plan and requirements.
 - 1. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
 - 1. Use Form CWM-2 for demolition waste.
- C. Waste Reduction Work Plan:
 - 1. List each type of waste and whether it will be salvaged or recycled. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - a. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - b. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis:
 - 1. Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan.
 - a. Use Form CWM-6 for demolition waste.
 - 2. Include the following:
 - a. Total quantity of waste.
 - b. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 - c. Total cost of disposal (with no waste management).
 - d. Savings in hauling and tipping fees by donating materials.
 - e. Savings in hauling and tipping fees that are avoided.
 - f. Handling and transportation costs. Include cost of collection containers for each type of waste.
 - g. Net additional cost or net savings from waste management plan.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- A. Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract:
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00 - Temporary Facilities and Controls.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

- C. Training:
 - 1. Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work:
 - a. Distribute waste management plan to everyone concerned within three (3) days of submittal return.
 - b. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls:
 - 1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities:
 - a. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - b. Comply with Section 01 50 00 - Temporary Facilities and Controls for the control of dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 DISPOSAL OF WASTE

- A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction:
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

END OF SECTION 01 74 19

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00 - Project Management and Coordination.

1.3 SUBSTANTIAL COMPLETION

- A. Items listed in Supplementary Conditions, Article 9, Section 9.8 "Substantial Completion" and the following items shall be completed before Substantial Completion will be granted:
 - 1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
 - 2. Architect's Supplemental Punch List: The Architect, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 - 3. Operations and Maintenance Manuals: Submit as described in "Operations and Maintenance Manuals" article below.
 - 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in "Final Cleaning" and "Protecting Installed Construction" articles below.
 - 5. Testing and Balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect shall prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.4 PUNCH LIST

- A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.
- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
 - 1. Room number or other suitable location identifier
 - 2. Description of the work

3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 4. Sub-contractor/trade sign-off date
 5. Contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 6. Contractor/trade sign-off date
 7. Architect consultant sign-off
 8. Architect consultant sign-off date
 9. If requested by Owner, provide two additional similar columns for their signoff.
 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the Contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for reinspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
- D. A significantly large number of items to be completed or corrected will preclude Architect from issuing a Certificate of Substantial Completion. Owner and Architect will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion will be no longer than five (5) typed pages.
- E. Contractor's superintendent shall participate in the preparation of Contractor's punch list that is submitted to Architect and Owner for supplementation. Upon receipt, Architect and Consultants shall perform a spot review to determine the adequacy and completeness of Contractor's punch list.
- F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany Architect, their Consultants and Owner (at their discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
1. Superintendent shall record or otherwise take note of all supplementary items.
 2. Architect shall endeavor to furnish to Contractor typed, hand-written, or recorded supplements to the punch list in a prompt manner; however, any delay in Contractor's receiving said supplements from Architect will not be cause for a claim for additional cost or extension of time as Contractor's Superintendent shall have been in attendance during the observations of Architect and their Consultants and will have been expected to take their own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.
- C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, etc.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

- F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Equipment start-up instructions
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Product data.
 - b. Air and water balance reports.
 - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- G. Submit one (1) final original and two (2) copies to Architect.
- H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants, and Owner: Closeout manual, Material Safety Data Sheet (MSDS) binder, Operations and Maintenance (O&M) Manuals, specifications, and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.6 PROJECT CLOSEOUT

- A. Final Payment will not be authorized by Architect until Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable contract requirements:
 - 1. Close-out Documents: Provide bound closeout documents as described in "Closeout Documents" article below. Refer to Supplementary Conditions, Article 9, Section 9.10 "Final Completion and Final Payment" for additional information.
 - 2. Record Documents: Submit as described in "Project Record Documents" article below.
 - 3. Extra Materials: Provide extra stock, materials, and products as described in "extra Stock, Materials, and Maintenance Products" article below when required by individual specification sections.
 - 4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
 - 6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in "Warranties, Certificates, and Bonds" article below.
 - 7. Final Examination and Acceptance by Architect: As described in "Final Examination" article below.

1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Section 00 73 00 - Supplementary Conditions.

- B. Prepare 3-ring D-slant binder cover and spline with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.
- E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers. All Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Section 00 40 12.
 - 2. Part 2: Closeout Documents and Affidavits, include the following:
 - a. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
 - b. AIA G706A - Contractor's Affidavit of Release of Liens;
 - c. AIA G707 - Consent of Surety to Final Payment;
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Copy of Certificate of Substantial Completion (AIA G704);
 - b. Copy of All Permits;
 - c. Copy of Final Utility Bill or letter of transfer;
 - d. Copy of Certificate of Occupancy;
 - 4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
 - a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by Contractor's own forces, and warranty period for each section of Work;
 - b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached 01 77 01 - Closeout Form A - Subcontractor's Affidavit of Release of Lien.
 - c. Hazardous Material Certificate: Affidavits from Contractor, Subcontractors, and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project. Submit on attached 01 77 02 - Closeout Form B - Subcontractor Hazardous Material Certificate.
 - d. Subcontractor's Warranty: Provide notarized Warranty stating all sections of Work performed by subcontractor and warranty period. Submit on attached 01 77 03 - Closeout Form C - Subcontractor Warranty.
 - e. Special / Extended Warranties; List and provide, notarized warranties requested by Owner, or required by or incorporated in the Contract Documents.
 - f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.
 - 5. Part 5: Receipts:
 - a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
 - b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized Owner's representative.
 - c. Sign in sheets: provide signatures of attendees from all demonstrations.

- F. In addition to the three (3) required close-out binders listed above, provide Architect with one (1) separate binder for their records containing the following:
 - 1. Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers;
 - 2. All MSDS sheets for the project;
 - 3. All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.
- G. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.8 FINAL CLEANING

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.9 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection as specified in Section 01 56 00 - Temporary Barriers and Enclosures and where specified in individual specification sections until Work is accepted by Architect and Owner.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent 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.

1.10 PROJECT RECORD DOCUMENTS

- A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect is achieved in accordance with the Owner's requirements.
- B. At Contractor's request, and with associated fee, Architect may provide electronic versions of the construction drawing and specification files for Contractor's use, subject to the terms and conditions of Architect's standard electronic document transfer agreement.
- C. Submit reproducible to respective consultants (Civil, Structural, MEP, etc.) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.

1.11 EXTRA STOCK, MATERIALS, AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site or to Owner's Maintenance Department as directed by Owner; obtain signed receipt from Owner's Designated Representative (ODR) prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's Designated Representative (ODR) may constitute breach of this requirement and may require delivery of additional materials at no cost to Owner if original materials are misplaced.

- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.12 WARRANTIES, CERTIFICATES, AND BONDS

- A. Definitions:
 - 1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to Owner.
 - 2. Special Warranties: Written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under General Conditions, Article 3, Section 3.5 "Warranty" as amended by the Supplementary Conditions, Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. Contractor's one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit Owner's rights with respect to latent defects, gross mistakes, or fraud.
- C. Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under General Conditions, Article 12, Section 12.2 "Correction of Work".
- D. No service charges or call out charges are allowed to investigate warranty claims.
- E. In addition to Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which Contractor has under the Contract Documents.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.
- G. Warranty Requirements:
 - 1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
 - 2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 - 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for the cost of replacing defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 - 4. Written warranties made to Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.
 - 5. Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Compile copies of each required warranty properly executed by Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to Architect.

1.13 FINAL COMPLETION AND FINAL PAYMENT

- A. Final Notice and Examination:
 - 1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to Architect that the Work is ready for final examination.
 - 2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, Architect will make final examination.
- B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by Architect until Contractor completes all requirements for close-out to the satisfaction of Owner and Architect as described herein.

1.14 FINAL EXAMINATION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and Owner. Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of final examination.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of Architect and Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 01 77 00

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SECTION 01 77 01 - CLOSEOUT FORM A - SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF TEXAS.

COUNTY OF _____.

KNOW ALL MEN BY THESE PRESENTS:

_____, being duly sworn, deposes and says:

That they are the _____ of _____, the subcontractor who supplied, installed, and/or erected the Work described below, and that, they are duly authorized to make this Affidavit and Subcontractor Release.

PROJECT: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT: PBK ARCHITECTS, INC.

WORK PERFORMED: _____

SPECIFICATION SECTION(S): _____

That all Work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.

That they have received full payment of all sums due them for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

Name of Subcontractor: _____

Attested By: _____ Title: _____

Jurat

State of Texas.

County of _____.

Sworn to and subscribed before me on this _____ day of _____, 20__.

Notary Public: _____ Seal: _____

END OF SECTION 01 77 01

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**SECTION 01 77 02 - CLOSEOUT FORM B - SUBCONTRACTOR HAZARDOUS MATERIAL
CERTIFICATE**

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF TEXAS.

COUNTY OF _____.

PROJECT NAME: NORTHEAST LAKEVIEW COLLEGE, SUNDANCE RENOVATION

OWNER: ALAMO COLLEGES DISTRICT - NORTHEAST LAKEVIEW COLLEGE

ARCHITECT: PBK ARCHITECTS, INC.

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he/she is the
_____ of _____, the subcontractor / supplier who
constructed or provided the section(s) of Work referenced above, and that they are duly
authorized to certify to the best of their information, knowledge, and belief no asbestos, lead or
PCB containing products have been incorporated into the project.

NAME OF SUBCONTRACTOR: _____

ATTESTED BY: _____ **TITLE:**

JURAT

STATE OF TEXAS.

COUNTY OF _____.

Sworn to and subscribed before me on this _____ day of _____, 20__.

Notary Public: _____ Seal:

END OF SECTION 01 77 02

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SECTION 01 77 03 - CLOSEOUT FORM C - SUBCONTRACTOR WARRANTY

SUBCONTRACTOR WARRANTY

STATE OF TEXAS.

COUNTY OF _____.

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

That they are the Subcontractor (or the _____ of _____ the subcontractor), the subcontractor / supplier who supplied, installed, and / or erected the Work described below, and that, they are duly authorized to make this Subcontractor Warranty:

Project: Northeast Lakeview College, Sundance Renovation

Owner: Alamo Colleges District - Northeast Lakeview College

Architect: PBK Architects, Inc.

Work Performed: _____

Specification Section(s): _____

The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner, or Architect.

The Subcontractor warrants the Work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

NAME OF SUBCONTRACTOR: _____

ATTESTED BY: _____ **TITLE:** _____

JURAT

STATE OF TEXAS.

COUNTY OF _____.

Sworn to and subscribed before me on this _____ day of _____, 20__.

Notary Public: _____ Seal: _____

END OF SECTION 01 77 03

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SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section establishes general and administrative requirements pertaining to Commissioning (Cx) of equipment, devices, and building systems on the project. Technical requirements for Commissioning of particular systems and components are established in the respective technical sections of this Project Manual.
- B. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR), and the Basis of Design (BOD). During Commissioning, Contractor shall systematically demonstrate to Owner or Owner's Designated Representative (ODR) that operable systems have been installed and perform in strict accordance with the Contract Documents.
- C. Commissioning requires cooperation and involvement of all parties throughout the construction process. Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred Tests approved in advance by Owner.
- D. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to Owner, and training of Owner's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning shall achieve the following specific objectives of the Contract Documents:
 - 1. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.
 - 2. Ensure that Operating and Maintenance (O&M) and Commissioning documentation requirements are complete.
 - 3. Provide Owner with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Basis of Design (BOD).
 - 2. Commissioning (Cx).
 - 3. Commissioning Authority (CxA).
 - 4. Contract Documents.
 - 5. Control Point and Sensor Calibration Verification.
 - 6. Deferred Testing.
 - 7. Deficiency.
 - 8. Functional Performance Test (FPT).
 - 9. Functional Performance Testing Procedures.
 - 10. Integrated Systems Test (IST).
 - 11. Integrated Systems Testing Procedures.
 - 12. Operational Testing.
 - 13. Owner's Project Requirements (OPR).

14. Project Documents.
15. System Verification Checklist (SVC).
16. Start-up.
17. Training Plan.
18. Trending.

1.4 COMMISSIONING TEAM

- A. Owner shall appoint the following Members:
 1. Owner's Project Manager and any other designated representatives of Owner's staff.
 2. Commissioning Authority (CxA).
 3. Architect.
 4. Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA.
- B. Contractor shall appoint the following Members:
 1. Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical, Electrical, Plumbing, Building Automation) shall have a dedicated representative.
 2. Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.
 3. Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

1.5 ROLES AND RESPONSIBILITIES

- A. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. Respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.
- B. Owner's Roles and Responsibilities:
 1. Provide guidance in development of the Owner's Project Requirements (OPR).
 2. Review Technical Specifications containing Commissioning requirements.
 3. Approve the Commissioning Scope of Work and schedule of Commissioning activities.
 4. Assign Owner's Designated Representative (ODR)(s) and schedule them to participate in Commissioning activities, including the following:
 - a. Commissioning Team meetings.
 - b. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.
 - c. Attend Owner Training sessions in operation and maintenance of systems and equipment.
 - d. Observation of Contractor's demonstration of systems and equipment operation.
- C. Commissioning Authority's (CxA) Roles and Responsibilities:
 1. Prepare the Commissioning Plan with Owner's and Contractor's review and input.
 2. Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by Contractor to understand the progress of construction activities on the project.
 3. Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.
 4. Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.

5. Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.
 6. Following submittal review and approvals by the Architect's team, review the sequences of operation and coordinate with the Contractor and Architect's Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to Owner and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.
 7. Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by Contractor to permit energizing or start-up in accordance with the Contract Documents; CxA shall issue written notice to Owner and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by Contractor for major equipment energizing and start-ups as executed by Contractor with appropriate notice as indicated herein.
 8. Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.
 9. Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.
 10. Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to Owner Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to Owner.
 11. Review Contractor's Training Plan and individual training agendas for compliance with the requirements in the Contract Documents. Recommend acceptance to Owner prior to Contractor scheduling training sessions with Owner. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of Owner's personnel to evaluate the effectiveness of the Owner Training.
 12. Compile the Final Commissioning Process Report and submit to Owner for review and approval.
- D. Architect's Roles and Responsibilities:
1. Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.
 2. Incorporate Commissioning requirements into the Contract Documents if requested by Owner.
 3. Attend Commissioning Team meetings.
 4. Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by Owner or the Contract Documents.
 5. Review Contractor's Training Plan and provide comments to Owner.
 6. Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.
 7. Review Operating and Maintenance Manuals and provide comments to Owner.
- E. Contractor's Roles and Responsibilities:
1. Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by Owner.

2. Provide an individual, subject to Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to Owner for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.
3. Furnish and install systems that meet all requirements of the Contract Documents.
4. Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. Contractor shall coordinate with CxA and Owner to determine the required activities, durations and predecessors.
5. Submit inspection requests, start-up requests and all supporting documentation in accordance with the Contract Documents, General Conditions, and Commissioning Plan.
6. Cooperate with Owner's Designated Representative (ODR)(s), provide access to work and provide adequate labor, resources, and time for Commissioning.
7. Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians to Owner. This requirement does not supersede any additional requirements contained in the Contract Documents.
8. Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect, Owner, and CxA to attend the pre-installation meetings and pre-commissioning meetings.
9. Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.
10. Correct deficiencies identified during any stage of the Commissioning process.
11. Coordinate with the CxA to develop the Training Plan and submit to Owner for approval. Provide training to Owner's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with Owner to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.
12. Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.
13. Perform system maintenance during construction as specified and requested by Owner and send the maintenance records to Owner for Record.
14. Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

1.6 SYSTEMS TO BE COMMISSIONED

- A. The following systems shall be commissioned according to the process defined in this Section:
 1. Major HVAC Systems (100% including but not limited to the list below):
 - a. Air Handling Units.
 - b. Fan Coil Units.
 - c. Exhaust Fans.
 - d. Supply Fans.

- e. Pumps.
- f. Chillers.
- g. Boilers.
- 2. Terminal Units (10% Sampling).
- 3. Building Automation System.
- 4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed).
- 5. Lighting - Daylight Controls (100%).
- 6. Lighting - Time Switch Controls (100%).
- 7. Normal and Emergency Power Systems.

PART 2 PRODUCTS

2.1 COMMISSIONING PLAN

- A. Document developed by CxA that provides structure, schedule, and coordination plan for Commissioning Process from Pre-construction phase through Occupancy Phase. Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.
- B. Commissioning Plan shall comply with the Owner's Project Requirements (OPR).
- C. Commissioning Team shall review the Commissioning Plan prior to Pre-Commissioning Meeting and submit written comments or questions to CxA to be addressed in the meeting.
- D. Following Pre-Commissioning meeting, CxA shall incorporate all changes discussed and agreed upon in Pre-Commissioning meeting and submit Final Commissioning Plan to Commissioning Team for approval and acceptance.
- E. If changes to Commissioning Plan are needed during the Commissioning Process, CxA shall edit the plan and distribute to Commissioning Team for approval and acceptance.
- F. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor. Contractor shall ensure that all sub-contractors and vendors agree and accept Commissioning Plan.

2.2 SYSTEM VERIFICATION CHECKLISTS

- A. System Verification Checklists (SVCs) are important to ensure that equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document inspections and procedures necessary to take a piece of equipment from a static state into an operating state. When combined, these checklists augment manufacturer's start-up checklists to provide a complete document from procurement to start of Functional Performance Testing.
- B. CxA shall develop System Verification Checklist templates for review by Cx Team. Contractor, appropriate Subcontractors, and Vendors shall support CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by CxA and reviewing and commenting on the checklist templates in accordance with Project Specifications and Commissioning Plan.
- C. Once the checklist templates are reviewed and accepted, CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).
- D. CxA shall provide login access and training to Contractor and other members of Cx Team in use of electronic commissioning database.

- E. Contractor shall be responsible for completing required sections of System Verification Checklists utilizing electronic commissioning database and providing all supporting documentation via electronic transmittal to CxA. Additional requirements for completion of SVCs are included in this section and other technical sections of Specifications.
- F. Once equipment arrives on project site, Contractor or sub-contractors shall begin completing individual checklists and continue throughout installation process. Checklists are meant to be progressive and a tool for tracking progress.
- G. Once SVCs are electronically completed, CxA will review and approve checklists and supporting documentation and compile information to include in the Final Commissioning Process Report.

2.3 FUNCTIONAL PERFORMANCE TESTING PROCEDURES:

- A. Functional Performance Testing Procedures are to verify and document that equipment and systems on project individually perform in accordance with the requirements in the Contract Documents and meet Owner's Project Requirements.
- B. CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. Contractor shall provide any supporting information to CxA that may be needed including, but not limited to, product submittals, O&M information, and sequences of operation. Once developed, CxA will issue to Cx Team for review and comment.
- C. Commissioning Team shall review Functional Performance Test procedures and submit written comments or questions to CxA. Contractor shall ensure that sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.
- D. CxA will coordinate with Cx Team to address any comments and produce final FPT procedures for acceptance by Cx Team. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor.
- E. Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

2.4 INTEGRATED SYSTEMS TESTING PROCEDURES:

- A. Integrated Systems Testing Procedures are to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- B. CxA shall develop specific script-type test procedures to verify and document proper operation of integrated systems throughout facility. Contractor shall provide any supporting information to CxA that may be needed including, but not limited to, product submittals, O&M information, and sequences of operation. Once developed, CxA will issue to Cx Team for review and comment.
- C. Commissioning Team shall review Integrated Systems Testing procedures and submit written comments or questions to CxA. Contractor shall ensure that sub-contractors and any vendors that would be involved with Integrated Systems Testing review procedures and provide comments.
- D. CxA shall coordinate with Cx Team to address any comments and produce final IST procedures for acceptance by Cx Team. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor.
- E. CxA shall also develop IST personnel matrix that will be utilized to track individual testing teams involved with IST. CxA will distribute the matrix to Cx Team so that Contractor and Owner can assign appropriate personnel to each team.
- F. CxA shall also host a coordination meeting prior to IST to review IST procedures, complete any final coordination, review safety procedures, and answer any questions.

- G. CxA estimates there will be two Integrated Systems Tests on project. Requirements for testing are included in the respective technical sections of Project Manual.
 - 1. First IST shall test _____.
- H. IST procedures shall be utilized by Contractor for any pre-testing activities prior to official Integrated Systems Testing.

2.5 TRAINING PLAN

- A. Contractor, in coordination with Owner and CxA, shall develop Training Plan with project specific requirements for Owner Training, after reviewing the different systems to be installed and commissioned. Training Plan is to specifically communicate required content and training durations required by Owner based upon the type of equipment and Owner's past experience.
- B. Contractor shall review all individual technical sections of this Project Manual for specific training requirements.
- C. Contractor shall coordinate with Owner to ensure that the proposed training requirements meet Owner's needs and expectations.
- D. Contractor shall coordinate with sub-contractors and vendors to ensure Owner Training requirements can be achieved and gather any additional information or recommendations.
- E. Any changes to training requirements in this specification must follow contractual protocols.
- F. Training Plan shall include a list of systems and equipment for which training will be provided according to three-tiered training approach outlined in Project Manual.
- G. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:
 - 1. Session Objectives.
 - 2. Proposed Instructor(s).
 - 3. Instructor Qualifications.
 - 4. Training Materials that will be provided.
 - 5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.).
 - 6. Applicable specification sections and O&M Manual sections.
 - 7. Detailed outline of training session content.
- H. Contractor shall coordinate with CxA to organize systemic training sessions comparable to organization of Systems Manual.
- I. Owner training must be completed prior to the contractor obtaining substantial completion by Owner.

2.6 FINAL COMMISSIONING PROCESS REPORT

- A. CxA shall prepare Final Commissioning Process Report that will include the following:
 - 1. Executive Summary.
 - 2. Participants and Roles.
 - 3. Brief building description.
 - 4. Overview of commissioning and testing scope.
 - 5. General description of testing and verification methods.
 - 6. Appendices with supporting information, issues log, and communications.
- B. Contractor shall coordinate with CxA to provide any additional information that may be needed to complete Final Commissioning Process Report.
- C. Contractor shall resolve any outstanding commissioning items prior to CxA preparing Final Commissioning Report.

- D. CxA shall issue Final Commissioning Process Report to Cx Team for review. Owner shall approve Final Commissioning Process Report after any comments or discrepancies are resolved by CxA.

PART 3 EXECUTION

3.1 PROJECT SCHEDULE

- A. Contractor shall integrate all Commissioning activities into detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite Commissioning Process.

3.2 COMMISSIONING TEAM MEETINGS

- A. Upon obtaining Owner's approval of the Commissioning Plan, CxA shall coordinate with Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in Commissioning process. Meeting should include major subcontractors, specialty manufacturers/suppliers, Architect, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's Designated Representative (ODR)(s) as participants.
- B. Contractor shall prepare for Pre-Commissioning Meeting by supplying the following documents created by CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures, and Example Integrated Systems Test Procedures.
- C. CxA shall conduct Pre-Commissioning Meeting and review all aspects of Commissioning Plan and applicable specifications.
- D. Commissioning Plan shall be reviewed with all attendees and scope of work discussed. Contractor should be prepared to distribute copies of pertinent sections to subcontractors involved in Commissioning process.
- E. Final outcome of the meeting shall be an understanding of commissioning process, roles and responsibilities, and consensus acceptance of Commissioning Plan by Cx Team.
- F. Contractor may request additional meetings with CxA and individual sub-contractors to clarify roles, responsibilities, and procedures as needed.

3.3 TEST EQUIPMENT

- A. Contractor shall provide all specialized tools, test equipment, and instruments required to execute start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

3.4 REPORTING

- A. Beginning at the procurement stage for equipment included in Cx scope, Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.
- B. Contractor shall submit Deficiency reports to Owner within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.

3.5 DEFICIENCY RESOLUTION

- A. CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). CxIL shall be distributed electronically to Cx Team at regular intervals.

- B. Contractor shall respond in writing to CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. Contractor should utilize CxIL responses to update Cx Team on the progress of deficiency resolution.
- C. Contractor shall respond to CxA and Owner indicating CxIL items that are completed and ready for CxA to verify completion.
- D. If any item indicated complete by Contractor is found to be incomplete by CxA upon re-verification, Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.

3.6 REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT

- A. Owner and/or Owner's Designated Representative (ODR) may install lockout devices on equipment in addition to Contractor's lockout / tagout devices once permanent power is connected to facility. This lock would be removed once proper start-up notification is received by Owner and/or CxA, and CxA has reviewed the appropriate SVCs and supporting documentation to verify equipment is ready for energizing and/or start-up.
- B. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by Authorities Having Jurisdiction (AHJ).
- C. Contractor shall notify Owner and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to scheduled start-up.
- D. Contractor shall complete applicable sections of System Verification Checklist(s) evidencing Contractor's thorough inspection of system and readiness for start-up activities as required by Contract Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to Owner and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.
- E. CxA shall review SVCs and supporting documentation within the 72 hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.
- F. CxA and/or Owner may witness equipment energizing and/or start-up at scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.
- G. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Contract Document requirements.
- H. Contractor shall complete all required factory start-up documentation and applicable items in System Verification Checklists, prior to startup, to ensure compliance with the requirements in Contract Documents.

3.7 OPERATIONAL TESTING

- A. Once the appropriate start-up activities are completed, Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.
- B. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to Owner and/or CxA for review.
- C. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).

- D. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.
- E. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to Owner and/or Commissioning Authority.
- F. Contractor shall notify Owner and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to scheduled activities. Owner may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner's Designated Representative (ODR)(s) as needed.
- G. CxA shall review SVCs and supporting documentation within 72 hour notice period and confirm in writing that systems and equipment are approved to proceed with Functional Performance Testing.
- H. If any item indicated complete by Contractor is found to be incomplete by CxA, upon re-verification, Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

3.8 CONTROL POINT AND SENSOR CALIBRATION VERIFICATION

- A. Automation systems installed on project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.
- B. Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.
- C. TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.
- D. CxA will witness, at their discretion, this verification and/or independently verify and document results to be included in Final Commissioning Process Report.
- E. These activities must be completed prior to Contractor requesting Functional Performance Testing as indicated herein.

3.9 FUNCTIONAL PERFORMANCE TESTING

- A. Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.
- B. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with Contract Documents, Commissioning Plan and applicable Functional Performance Testing procedures.
- C. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- D. CxA and members of Cx Team, including Owner's personnel, may observe Functional Performance Testing of equipment components and systems. CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record results of all testing activities.
- E. CxA shall record any deficiencies noted during the testing in CxIL. If significant deficiencies exist, the Owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by Contractor. Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.

- F. All Functional Performance Testing of Integrated Systems must be completed in accordance with Project Documents and Commissioning Plan prior to Contractor scheduling the Integrated Systems Testing activities.

3.10 INTEGRATED SYSTEMS TESTING

- A. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.
- B. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to accepted Integrated Systems Testing procedures developed by CxA. CxA shall facilitate and document testing, organizing appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.
- C. Integrated Systems Testing typically involves multiple teams with representation from CxA, Owner, and Contractor. Contractor shall provide any needed communication equipment (i.e., radios) or make available any centralized intercom or paging system for communication with all testing groups.
- D. Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to Personnel Matrix by CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this Section.
- E. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by Owner and/or CxA.
- F. CxA shall record any deficiencies noted during testing in CxIL. If significant deficiencies exist, Owner and/or CxA may request that testing activities be terminated and re-scheduled after proper verification by Contractor. Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

3.11 DEMONSTRATION AND OWNER TRAINING

- A. Contractor, in coordination with Owner and CxA, shall develop Training Plan with project specific requirements for Owner Training as required throughout various sections of the Specifications.
- B. Specific requirements for scheduling and conducting Owner Training are included in other sections of this Project Manual.
- C. Owner Training activities shall not occur until Training Plan is approved by Owner and Contractor has submitted all O&M information for review and use during the training sessions.
- D. Contractor shall notify the CxA of all training sessions. Contractor shall record training session attendance and Owner shall ensure appropriate personnel are in attendance.
- E. CxA shall ensure the content of the Owner Training sessions meets the requirements in the Contract Documents.
- F. CxA may conduct surveys of Owner's personnel to gauge effectiveness of Owner training sessions. If unfavorable surveys are received by Owner's personnel indicating unsatisfactory training, Owner reserves the right to require Contractor to re-train in those specific areas of non-conformance until requirements in the Contract Documents are satisfactorily completed.
- G. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

3.12 DEFERRED / SEASONAL TESTING

- A. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.
- B. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon Owner approval. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by Owner.
- C. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with Owner and/or CxA.
- D. CxA shall document any deferred testing activities and ensure appropriate Commissioning documents are updated. Contractor shall provide any additional documentation needed by CxA to complete these requirements.

END OF SECTION 01 91 13

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Furnishing all labor, materials, and equipment necessary for demolition, dismantling, cutting, and alterations as indicated, specified, and required for completion of the Contract, as applicable. Includes items such as the following:
 - a. Selective demolition of building elements for alteration purposes.

1.3 RELATED REQUIREMENTS

- A. Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 10 00 - Summary: Sequencing and staging requirements.
- D. Section 01 10 00 - Summary: Description of items to be removed by Owner.
- E. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- F. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- G. Section 01 57 13 - Temporary Erosion and Sediment Control.
- H. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- I. Section 01 73 00 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- J. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- K. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- L. Section 31 22 13 - Rough Grading: Topsoil removal.
- M. Section 31 22 13 - Rough Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- N. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- O. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- P. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.
- Q. Section 32 93 00 - Plants: Pruning of existing trees to remain.

1.4 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.6 EXISTING CONDITIONS

- A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make the Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

1.7 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during Work, notify the Architect promptly for instructions. Failure to notify will make The Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

3.2 SCOPE

- A. As indicated on Drawings.

3.3 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 73 00 - Execution.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.

2. Comply with applicable requirements of NFPA 241.
 3. Use of explosives is not permitted.
 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from the Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- F. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- H. If hazardous materials are discovered during removal operations, stop work and notify the Architect and the Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

3.4 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, Contractor shall be solely and completely responsible for working conditions at the jobsite, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Safety precautions prevent damage to existing elements identified to remain or to be salvaged and prevent injury to the public and workmen engaged onsite. Demolish roofs, walls, and other building elements in such a manner that demolished materials fall within foundation lines of building. Do not allow demolition debris to accumulate onsite. Pull down hazardous work at end of each day; do not leave standing or hanging overnight, or over weekends:
1. Protect existing items that are not indicated to be altered. Protect utilities designated to remain from damage.
 2. Protect trees, plant growth, and features designated to remain as final landscaping as indicated on Drawings.

3. Protect bench marks from damage or displacement.
- D. Any construction review of the Contractor's performance conducted by the geotechnical Engineer is not intended to include review of the adequacy of Contractor's safety measures in, on, or near the construction site.

3.5 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.6 PREPARATION

- A. Scheduling:
 1. General: Coordinate and schedule demolition work as required by the Owner and as necessary to facilitate construction progress.
- B. Hazardous Materials:
 1. General: Identify chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations, and notify such jurisdictional agencies as may be required. Collect and legally dispose of such materials at official disposal locations away from the site.
 2. Asbestos: If asbestos or materials containing asbestos are encountered, stop work immediately and contact the Owner. Do not proceed with demolition until directed by the Owner.
- C. Utility and Service Termination:
 1. Locate and identify existing utility, service, and irrigation system components affected by Work of this Contract. Review existing record Drawings, conduct site investigations, contact Underground Service Alert and other qualified cable/pipe/line locator services, and implement all other means necessary to define the location of underground systems.
 2. Prior to beginning any demolition, properly disconnect all water, gas, and electrical power supply at appropriate disconnect locations. Obtain all necessary releases and approvals from serving utility companies.
 3. Prior to demolition or disconnect, obtain the Owner's approval that such system does not impact facilities or systems beyond the extent of this Contract.
 4. Mark location of disconnected systems. Identify and indicate stub-out locations on Project record documents.
- D. Verify that existing plant life and features designated to remain are tagged or identified.
 1. The Architect will mark the features, trees, and shrubs to remain within the construction area. The Contractor shall not commence clearing and grubbing operations until authorized by the Owner and all protective measures are in place.
- E. Coordinate the time and duration of all system disconnects with the Owner.

3.7 DEMOLITION

- A. General Requirements:
 - 1. Clear areas required for access to site and execution of Work, including pavement, structures, foundations, vegetation, trash, and debris.
 - 2. Coordinate with the Owner the time of day and route to remove demolished materials from premises.
 - 3. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.
 - 4. Remove all buried debris, rubble, trash, or other material not deemed suitable by the geotechnical Engineer.
 - 5. Fill all voids or excavations resulting from clearing, demolition, or removal of vegetation with specified fill material.
- B. Fixture and Equipment Removal:
 - 1. Remove existing fixtures and equipment as identified and shown on Drawings and required by the Architect.
 - 2. Verify all service connections to fixtures and equipment designated for removal have been properly disconnected.
 - 3. Remove all conductors from conduit at all abandoned circuits.

3.8 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction.
 - 2. Remove items indicated on Drawings.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Refer to Section 01 10 00 - Summary for other limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.9 UTILITY AND BUILDING SERVICES REMOVAL AND RE-INSTALLATION

- A. Where crossing paths and potential points of interference with existing utility services are shown or can be reasonably inferred from surface conditions or evidence of subsurface systems, such as meter boxes, vaults, relief vents, cleanouts, and similar components:
 - 1. Review all Contract Documents showing crossing paths and potential points of interference.
 - 2. Pot-hole or determine by other means the accurate depth and location of such utilities.
 - 3. Incorporate all costs required to complete work under this Contract, including additional trenching, re-routing of existing and new utilities, and all means necessary to construct work under this Contract.
 - 4. No additional cost to Owner will be allowed for work necessary to accommodate utility conflicts where such crossing paths are shown on Contract Drawings or can be reasonably inferred from surface conditions or components.
- B. Remove all conductors from conduit at all abandoned electrical circuits.
- C. Seal off ends of all piping, drains, and other components as directed by Architect and serving utility.
- D. Where necessary to maintain service to existing utility and building systems, relocate or redirect all conduit and conductors, piping, drains, and associated system components:
 - 1. Re-circuit all electrical as required.
 - 2. Re-circuit all landscape irrigation valving and control systems as required.
 - 3. Temporarily terminate landscape system components in approved boxes or with approved caps, suitable for re-connection or extension.
 - 4. Extend or otherwise modify all site drainage systems, including catch basins, drain inlets, and piping. Fine grade to maintain proper drainage flow pattern to drains.
- E. Demolish structure in an orderly and careful manner:
 - 1. Use of explosives prohibited.

3.10 DEBRIS AND WASTE REMOVAL

- A. Demolished materials become property of the Contractor and shall be removed from premises, except those items specifically listed to be retained by the Owner.
- B. Remove debris, junk, and trash from site on a daily basis.
- C. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and wind-blown debris from public and private lands.

3.11 CLEANING

- A. Upon completion of work of this Section, promptly remove from the working area all scraps and debris.
- B. Clean excess material from the surface of all remaining paved surfaces and utility structures.
- C. Power wash all concrete surfaces to remove stains, dried mud, tire marks, and rust spots.

END OF SECTION 02 41 00

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Clear penetrating sealers.

1.3 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- D. ACI 305R - Guide to Hot Weather Concreting; September 2020.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.
- F. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- G. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- E. Specimen Warranty: Manufacturer warranty.

1.6 QUALITY ASSURANCE

- A. For slabs indicated to receive concrete polishing system, do not proceed with concrete polishing unless manufacturer's representative and specialized equipment is present for every day of placement.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.8 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Concrete Sealers USA: www.concretesealersusa.com.
 - 2. SureCrete Design Products: www.surecretedesign.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:
 - (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
 - (b) ACI 301, "Specifications for Structural Concrete."
 - (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
 - (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
 - (e) ACI 305R, "Guide to Hot Weather Concreting."
 - (f) ACI 306R, "Guide to Cold Weather Concreting."
 - (g) ACI 318, "Building Code Requirements for Structural Concrete and Commentary."

2.3 CONCRETE FLOOR FINISH APPLICATIONS

- A. Typical Concrete Finishing:
 - 1. Unless otherwise indicated, all exposed concrete floors are to be finished using penetrating sealer.

2.4 COATINGS

- A. Penetrating Sealer: Transparent, nonyellowing, water- or solvent-based coating.
 - 1. Composition: Siloxane.
 - a. Basis of Design Products:
 - 1) Products manufactured by Concrete Sealers USA.
 - 2) Products manufactured by SureCrete Design Products.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.

- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION 03 35 00

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SECTION 03 54 00 - CAST UNDERLAYMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum-Based Underlayment.
 - 2. Cementitious Underlayment.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 73 00 - Execution: Alteration project procedures; selective demolition for remodeling.

1.3 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- D. ASTM C219 - Standard Terminology Relating to Hydraulic and Other Inorganic Cements; 2024.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- F. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- G. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.
- H. ASTM E989 - Standard Classification for Determination of Single-Number Metrics for Impact Noise; 2021.
- I. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
- J. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- K. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Manufacturer's Instructions.

1.5 QUALITY ASSURANCE

- A. STC Rated Assemblies:
 - 1. For STC rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- B. IIC Rated Assemblies:

1. For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E492 and classified according to ASTM E989 by an independent testing agency.
- C. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F (41 degrees C).

1.7 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Gypsum-Based Underlayment:
 2. Cementitious Underlayment:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 2. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:
 - (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
 - (b) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
 - (c) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."

2.3 MATERIALS

- A. Cast Underlayments, General:
- B. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 1. Basis of Design Products:
 2. Compressive Strength: Minimum 2500 pounds per square inch (17.24 MPa), tested per ASTM C472.

3. Density: Maximum 115 pounds per cubic foot (1842 kg/cu m).
 4. Final Set Time: 1 to 2 hours, maximum.
 5. Thickness: 3/4 inch (19 mm) to maximum 3-1/2 inch (89 mm).
 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- C. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's instructions will produce self-leveling underlayment with the following properties:
1. Basis of Design Products:
 2. Material:
 - a. High-strength, calcium-aluminate-based, self-leveling concrete underlayment: packaged, dry mix for leveling concrete.
 - b. Cement Binder:
 - 1) ASTM C150/C150M, portland cement defined by ASTM C219.
 - c. Underlayment Additive:
 - 1) Resilient emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
 3. Compressive Strength:
 - a. Minimum 4000 pounds per square inch (27.6 MPa) after 28 days, tested per ASTM C109/C109M.
 4. Flexural Strength:
 - a. Minimum 1000 psi (6.9 MPa) after 28 days, tested per ASTM C348.
 5. Density:
 - a. 125 pounds per cubic foot (2002 kg/cu m), nominal.
 6. Final Set Time:
 7. Thickness:
 - a. Capable of thicknesses from feather edge to maximum 3-1/2 inch (89 mm).
- D. Primers:
1. Description:
 - a. Low-VOC, water-base acrylic primer used before the installation of underlayment materials.
 2. Performance:
 - a. Polymer Type: Acrylic.
 - b. Percent Solids: 43% to 45%.
 - c. VOCs: 91.9 oz./cu. ft (92 g / L).
 - d. pH: 7 to 8.
 - e. Color: White.
 3. Basis of Design Product:
 - a. Primer T manufactured by MAPEI Corporation.
- E. Water:
1. ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- F. Primer:
1. As recommended by manufacturer.
- G. Joint and Crack Filler:
1. Latex based filler, as recommended by manufacturer.

2.4 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.

- B. Add aggregate for areas where thickness will exceed 1/2 inch (12.7 mm). Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

- A. Concrete Substrates:
 - 1. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, plasticizers, and contaminants that might impair underlayment bond.
 - 2. Do not use acid etching.
 - 3. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water / 1000 sq. ft (1.36 kg of water / 100 sq. m) in 24 hours.
- B. Metal Substrates:
 - 1. Mechanically remove, according to manufacturer's written instructions, rust, Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.
- C. Non-Porous Substrates:
 - 1. For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and contaminants that impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Wood Substrates:
 - 1. Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
 - a. Install underlayment reinforcement recommended in writing by manufacturer.
- E. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- F. Vacuum clean surfaces.
- G. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- H. Close floor openings.
- I. Adhesion Tests:
 - 1. After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum adhesion to substrate and between coats.

3. At substrate expansion, isolation, and moving joints, allow joint of same width to continue through underlayment.
4. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- B. Apply underlayment to produce uniform, level surface. Apply final layer without aggregate to product surface. Feather edges to match adjacent floor elevations.
- C. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
 1. Floor Surface Receiving Carpet:
 - a. Finish surfaces to specified tolerances, according to ASTM E1155, for randomly trafficked floor surface receiving carpet or carpet tile:
 - b. Specified Overall Values (SOV):
 - (a) Flatness: F_F 25.
 - (b) Levelness: F_L 20.
 - c. Minimum Local Values (MLV):
 - (a) Flatness: F_F 17.
 - (b) Levelness: F_L 15.
 2. Floor Surface Receiving Resilient Floor Covering:
 - a. Finish surfaces to specified tolerances for slabs on grade, according to ASTM E1155, for randomly trafficked floor surface receiving a thin filmed floor covering such as resilient tile, resilient sheet flooring:
 - 1) Specified Overall Values (SOV):
 - (a) Flatness: F_F 35.
 - (b) Levelness: F_L 25.
 - 2) Minimum Local Values (MLV):
 - (a) Flatness: F_F 24.
 - (b) Levelness: F_L 17.
 3. Floor Surface Receiving Large Format Tile:
 - a. Finish surfaces to specified tolerances, according to ASTM E1155, for randomly trafficked floor surface receiving large format thin porcelain or ceramic tile, large format thin stone tile, and where very flat floor surface is required or recommended:
 - 1) Specified Overall Values (SOV):
 - (a) Flatness: F_F 50.
 - (b) Levelness: F_L 30.
 - 2) Minimum Local Values (MLV):
 - (a) Flatness: F_F 30.
 - (b) Levelness: F_L 24.
 4. For randomly trafficked floor surfaces, finish surface to specified tolerances, according to ASTM E1155:
 - a. Specified Overall Values (SOV):
 - 1) Flatness: F_F 45.
 - 2) Levelness: F_L 35.
 - b. Minimum Local Values (MLV):
 - 1) Flatness: F_F 30.
 - 2) Levelness: F_L 24.
- D. Pump or pour material onto substrate. Do not retemper or add water.
 1. Pump, move, and screed while the material is still highly flowable.
 2. Be careful not to create cold joints.
 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- E. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).

- F. For final thickness over 1-1/2 inches (38 mm), place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- G. Place before partition installation.
- H. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.4 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3.5 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION 03 54 00

SECTION 03 35 23 – EXPOSED AGGREGATE CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: **EXPOSED AGGREGATE ‘TOPCAST’ CONCRETE FINISH** produced through the use of a chemical surface retarder to expose the sand and fine aggregates of a concrete mix
- B. Related Sections: Refer to the following sections for related work

Section 02200: “Earthwork”

Section 03300: “Cast-In-Place Concrete”

Section 05500: “Metal Fabrications”

Section: 07900: “Joint Sealants”

1.2 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM)

C 31 Practices for Making and Curing Concrete Test Specimens in the Field

C 33 Specification for Concrete Aggregates

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C 94 Specification for Ready-Mixed Concrete

C 143 Test Method for Slump of Hydraulic Cement Concrete

C 150 Specification for Portland Cement

C 172 Practice for Sampling Freshly Mixed Concrete

C 231 Test Method for Sampling Air Content of Freshly Mixed Concrete by Pressure Method

C 260 Specification for Air-Entraining Admixtures for Concrete

C 494 Specification for Chemical Admixtures for Concrete

D 994 Specification for Preformed Expansion Joint Filler for Concrete

1.3 SUBMITTALS

- A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, “Submittal Procedures”.
- B. Samples-Verification Samples

- C. Product Data: Chemical Surface Retarders
- D. **Shop Drawings**-Include patterns and exposure depths.
- E. Include special reinforcement required for openings through concrete slabs or structures.
- F. Laboratory Test Reports: Submit concrete test materials test reports and mix design reports certifying that each material or item complies with or exceeds the specified requirements.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
 - 1. ACI 301 "Specifications for Structural Concrete for Buildings"
 - 2. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete"
 - 3. ACI 305 "Hot Weather Concreting"
 - 4. ACI 306 "Cold Weather Concreting"
 - 5. ACI 308 "Standard Practice for Curing Concrete"
 - 6. ACI 309 "Standard Practice for Consolidation of Concrete"
 - 7. ACI 318 "Building Code Requirements for Reinforced Concrete"
 - 8. ACI 347 "Recommended Practice for Concrete Formwork"
 - 9. CRSI "Manual of Standard Practice"
 - 10. SP-66 "ACI Detailing Manual"
- B. Installer Qualifications: Minimum 5 years' experience in work of this Section.
- C. Mock-up Panels: Prepare one mock-up panel at the project site to demonstrate proficiency of the contractor as well as determine the best procedures and degree of sand or aggregate exposure. Mock-up panels shall be a minimum of 5' x 5'. Contractor shall use the methods and materials proposed for use on the final installation. Uniformity in appearance of each panel shall be the responsibility of the contractor. The approved mock-up panel shall serve as a standard of appearance for the final work to be produced.
- D. Quality Control Testing During Construction: Contractor will engage independent concrete testing service for quality control during concrete construction operations.
 - 1. Notify owner's representative at least two (2) working days in advance of field operations requiring concrete testing, or of resumption of operations after stoppages.
 - a. tested seven (7) days, three (3) specimens tested twenty eight (28) days and one (1) specimen retained in reserve for later testing if required.

PART 2 – PRODUCTS

2.1 FORM MATERIALS

- A. Unless otherwise indicated, construct formwork with plywood metal, metal-framed plywood or other acceptable materials to provide continuous, straight, smooth exposed surfaces.
 - 1. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bowing or deflection.

2.3 CONCRETE MATERIALS

- A. **Exposed Aggregate Surface:** Concrete to receive an exposed aggregate surface shall contain a minimum of 560 lb of ASTM C 150 Type II Portland cement per cubic yard of concrete.

- B. Aggregates used in base mix shall not be limestone. Size to be 3/8" and maximum of 3/4" pea gravel or similar aggregate
- C. Water: Potable, clean, fresh, free from oils, acids, organic matter or other deleterious substances.
- D. Admixtures: All admixtures shall be specified in the mix design.
 - 1. Air-Entraining Admixtures: ASTM C 260
 - 2. Water-Reducing Admixture: ASTM C 494, Type A.
 - 3. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
 - 4. Chloride-containing Admixtures are not permitted.

2.4 RELATED MATERIALS

- A. Expansion Joint Materials
 - 1. Typical Building: ASTM D 994, preformed strips of a bituminous mastic compositions
 - 2. Slabs – in Ground and Sidewalks: ASTM D 1751, preformed expansion joint filler having relatively little extrusion and substantial recovery after release from compression.
 - 3. Sand finish expansion joint caulk while wet, match adjacent concrete color
- B. Liquid Membrane – Forming Curing Compound: ASTM C 309, Type I or I-D, Class A.

2.5 SURFACE RETARDER MANUFACTURERS

- A. Top-Cast by Dayton Superior
 - a. Follow product specifications for installation
 - b. Finish to be provided by Landscape Architect
- B. Sandscape Refined by Bomanite
 - a. Use in conjunction with Bomanite Color Hardener
 - b. Install per manufacturer's specifications
- C. Lithocast by Scofield a Sika brand
 - a. Finish to be provided by Landscape Architect
 - b. Install per manufacturer's specifications
 - c. Provide Scofield Cureseal after installation
- D. Admixtures
 - 1. Use water-reducing admixtures in all concrete.
 - 2. Use air-entraining admixture in all exterior exposed concrete.

2.6 PLANT, EQUIPMENT, MACHINES AND TOOLS

- A. General: Plant, equipment, machines and tools used in the workplace shall be subject to approval and shall be maintained in a satisfactory working condition at all times.
 - 1. Provide equipment with capability of producing the required product, meeting or exceeding grade controls, thickness control and smoothness requirements as specified.
 - 2. Use of equipment shall be discontinued if it produces unsatisfactory results.
 - 3. Owner's representatives shall have access to the plant and all equipment to ensure proper operation and compliance with the specifications at all times during construction.

PART – 3 EXECUTION

3.1 FORM SETTING

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.
- B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- C. Design formwork to be readily removable without impact, shock or damage to cast - place - concrete surface and adjacent materials.
- D. Provisions for other trades: Provide openings in concrete formwork and slabs to accommodate other trades.
- E. Tolerances: set forms with the upper edge true to line and grade with an allowable tolerance of $\frac{1}{4}$ " (6mm) in any 10 foot (3 m) long section.

3.2 PLACING REINFORCEMENT

- A. Comply with CRSI's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports.
- B. Clean reinforcement of all loose rust and mill scale, earth, ice, oil, concrete splatter from previous pours and other materials, which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- D. Install welded wire fabric of same gage in as long of lengths as is practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps of adjacent widths to prevent continuous laps in either direction.

3.3 PREPARATIONS FOR PLACING CONCRETE

- A. Remove water from excavations. Before placement, remove wood chips, shavings, and hardened concrete etc. from forms.
 - 1. Clean all equipment.
 - 2. Wet forms, except in freezing weather, or oil properly with approved release.
- B. Earth shall be uniformly moist when concrete is placed. Sprinkling method shall not be such as to form mud or pools of water. Watering sub-grade immediately prior to concrete placement is not sufficient to make the soil uniformly moist.
- C. Notify other trades to permit installation of their work. Coordinate installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

3.4 PLACING CONCRETE

- A. Notify owner's representative 24 hours in advance prior to placement.
- B. Filed Inspection: Do not place concrete until forms and reinforcing steel have been inspected and approved.
 - 1. Place Ready-Mix concrete within specified time after batching.
 - a. Below 40 degrees F (4 degrees C) See Cold Weather Placing
 - b. 40 – 85 degrees F (4-29 degrees C) 90 minutes
 - c. 86 – 90 degrees F (30-32 degrees C) 75 minutes
 - d. Above 90 degrees F (32 degrees C) 60 minutes

* Concrete exceeding delivery times may be rejected by the owner's representative

- 2. Adding Water: Do not add water after initial introduction of mixing water for batch except when slump of concrete is less than specified upon jobsite arrival and the maximum water/cement ratio has not been exceeded.
 - a. Notify owner's representative prior to adding any additional water.

- b. Add only water enough to bring concrete slump within the specified limits. Turn drum at least 30 additional revolutions at maximum mixing speed. Do not add water to batch at any later time.
 - c. Ensure that concrete strength meets or exceeds specified requirements, and water does not exceed maximum amount specified in the approved CONCRETE MIX DESIGN.
- C. General: Comply with ACI 304, as specified herein.
 - 1. Place concrete continuously or in layers of such thickness that the concrete will not be placed on a preceding layer which has hardened sufficiently to cause formation of seams or planes of weakness.
 - 2. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms:
 - 1. Consolidate placed concrete by high frequency mechanical vibrating equipment, supplemented as necessary by hand spading, rodding or tamping. Use equipment and procedures for
consolidation of concrete in accordance with ACI 309.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations not further visible effectiveness of the machines being used. Generally 16-20" apart.
 - c. At each insertion, limit duration of vibration time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operation, within the limits of construction joints, until placement of panel or section is completed. Maintain reinforcing in proper position during concrete placement operations
- F. Placing Concrete Sidewalks: Place concrete in forms in one (1) layer of such thickness that when consolidated and finished, sidewalks will be of thickness indicated.
- G. Cold Weather Placing: Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures, comply with ACI 306.
- H. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete place concrete in accordance with ACI 305 and as herein specified.

3.5 CONCRETE FINISHING

- A. General: The use of a rolling tamper, jitterbug or rolling jitterbug shall be considered when producing micro etched concrete surfaces. This will enable the finisher to create a denser surface paste with no obstruction due to the appearance of coarse aggregate, allowing for a uniform sand texture.
 - 1. Protect all curbs, borders and adjacent concrete and masonry surfaces, pavers, stones etc. that are not to receive retarder finish prior to concrete placement and retarder application using **Grace "Face Off"**
 - 2. Place concrete in the manner prescribed previously. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.

3. Allow the bleed water to evaporate the surface. It can then be floated using a wooden hand float or a bull-float preferably wooden to close the surface and surround the coarse aggregate with cement paste. Float to a uniform appearance. Follow float operations with hand trowels or Fresno steel trowels to create tight dense smooth surface. (This may require two or three passes depending upon mix design and or desired finish to be achieved)

NOTE: Do not burnish the surface or allow the micro etched surface to prematurely dry prior to the application of Top Cast.

B. Concrete Surface Retarders

- i. All surfacere retarders vary in application methods. Confirm with product specification before installation.
- ii. Spray Applied, film forming top surface retarder, calibrated for specific sized aggregates and finish requirements without plastic covering. Color coded to allow for ease of application and verification of grade being used as well as even and complete coverage.
- iii. Soon after the final seat finish has been completed spray surface retarder using a low-pressure sprayer with a 0.5gpm tip at a rate of 200—350 sq./ft. per gallon in a full hiding coat.
- iv. Wash surface with water rinse using stiff brooms and water hose or by high pressure washing with power equipment as early as 4- 6 hours in very hot weather or the following day up to 24 hours. Retarder removal intervals are dependent upon strength of the concrete mix, aggregate size and desired washing techniques. Earlier washing on the light etches may be necessary. Verify in accordance with the mock-up approval detailed herein.
- v. Rinse water and cement matrix removal shall be in accordance with local codes and should not be allowed to be washed or flow down to arroyos, storm sewers, ponds, streams or sanitary sewers by precipitation or other surface flows.
- vi. Prior to completion of the project, remove wash water residue from the site to location approved by the local district.

3.7 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Immediately cut out honeycomb, rock pockets and voids over ¼ inch (6mm) in any dimension as well as holes left by tie rods, bolts etc. down to solid concrete but, in no case to a depth less than 1 inch (25mm).
 1. Cut edges perpendicular to concrete surface.
 2. Thoroughly clean, dampen with water, and brush coat area to be patched with neat cement grout or proprietary bonding agent before placing cement mortar or proprietary patching compound.
- B. Remove and replace concrete with defective surfaces if defects cannot be repaired to the satisfaction of the owner's representative.
 1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface as well as stains and other discolorations that cannot be removed by cleaning.
 - a. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout or apply concrete bonding agent.
 - b. Mix Patching concrete of same materials to provide concrete of same type of class as original concrete.

- c. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

END OF SECTION 03 35 10.1

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bollards.
 - a. Door Device Mounting Post.
 - b. Metal Pipe Bollards, Fixed.
 - 2. Loose steel lintels.
 - 3. Miscellaneous steel, including steel angle corner guards and steel edgings.
 - 4. Accessories as necessary for complete installation.

1.3 REFERENCE STANDARDS

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- D. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- G. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- K. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2025a.
- L. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.
- M. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014 Edition, September 1, 2014
- N. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014 Edition, September 1, 2014
- O. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- P. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

- Q. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- R. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- S. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- T. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- U. ASTM A741 - Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail; 2011.
- V. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- W. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).
- X. ASTM A793 - Standard Specification for Rolled Floor Plate, Stainless Steel; 1996.
- Y. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- Z. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- AA. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.
- BB. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- CC. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- DD. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- EE. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.
- FF. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- GG. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2024.
- HH. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- II. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.
- JJ. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- KK. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- LL. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2024).
- MM. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- NN. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2024.
- OO. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2024.

- PP. ASTM F738M - Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs; 2002 Edition, April 10, 2002
- QQ. ASTM F836M - Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric); 2020 Edition, May 1, 2020.
- RR. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- SS. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- TT. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.
- UU. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- VV. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- WW. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- XX. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- YY. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- ZZ. MFMA-4 - Metal Framing Standards Publication; 2004.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance:
 - 1. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
 - a. All deadloads.
 - b. 500 pound live load placed on the countertop and vanity.
 - c. Deflection at Midspan: $L/1000$ times span or 1/8 inch (3 mm) whichever is less.
- B. Thermal Movements:
 - 1. Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum range in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
 - a. Temperature Range: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.
- B. Shop Drawings:
 - 1. Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items:
 - a. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding Certificates.
- E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this work for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle to prevent any type of damage to the fabricated work.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:

- a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Metal Surfaces, General:

1. Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
2. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
 - a. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
 - b. Material: Galvanized steel ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
 - c. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
 - d. Width of Channels: 1-5/8 inches (41 mm).
 - e. Depth of Channels: As indicated on Drawings.
 - f. Metal and Thickness: Galvanized steel complying with ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
 - g. Finish: Hot dip galvanized after fabrication.
3. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - a. Provide stainless steel fasteners for fastening aluminum.
 - b. Provide stainless steel fasteners for fastening stainless steel.
 - c. Provide stainless steel fasteners for fastening nickel silver.
 - d. Provide bronze fasteners for fastening bronze.
 - e. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563/A563M; and, where indicated, flat washers.
 - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A325/ASTM A325M, Type 3; with hex nuts, ASTM A563/A563M, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
 - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F1554 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy.
 - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.
 - 1) Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
 - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

- j. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
 - k. Post Installed Anchors:
 - 1) Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2) Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
 - l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts
- B. Aluminum:
- 1. Aluminum Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
 - 2. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
 - 3. Aluminum Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
 - 4. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- C. Bronze:
- 1. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).
 - 2. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
 - 3. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (lead red brass) or No. C84400 (lead semired brass).
- D. Cast Iron:
- 1. Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. Nickel:
- 1. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.
 - 2. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent lead nickel bronze).
- F. Stainless Steel:
- 1. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
 - 2. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
 - 3. Rolled Stainless Steel Floor Plate: ASTM A793.
- G. Steel:
- 1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 - 2. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
 - 3. Steel Tubing: ASTM A500/A500M, cold formed steel tubing.
 - 4. Rolled Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- H. Zinc Coated Steel Wire Rope: ASTM A741:
- 1. Wire Rope Fittings: Hot dip galvanized steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- I. Abrasive Surface Floor Plate:

1. Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel:
 - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1) IKG Industries, a division of Harsco Corporation.
 - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
- J. Fasteners:
 1. Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required:
 - a. Provide stainless steel fasteners for fastening aluminum.
 - b. Provide stainless steel fasteners for fastening stainless steel.
 - c. Provide stainless steel fasteners for fastening nickel silver.
 - d. Provide bronze fasteners for fastening bronze.
 - e. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
 - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM F3125/F3125M, Type 3 with hex nuts, ASTM A563/A563M, Grade C3 and, where indicated, flat washers.
 - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F593 with hex nuts, ASTM F594 and, where indicated, flat washers; alloy.
 - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
 - 1) Hot dip galvanize or provide mechanically deposited zinc coating where item being fastened is indicated to be galvanized.
 - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - j. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors
 - 1) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2) Material for exterior locations and where stainless steel is indicated: Alloy; Group 1 (A1) or Group 2 (A4), ASTM F593, and nuts, ASTM F594.
 - k. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
 - l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
- K. Miscellaneous Materials:
 1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Thnemec Company.

2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
7. Non-shrink, Non-Metallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
8. Concrete Materials and Properties: Composed of ASTM C150/C150M Type I Portland cement, ASTM C33/C33M sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8 inch with at least 95 percent passing a 3/8-inch sieve and not more than 10 percent passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi (20 MPa).

2.4 FABRICATION

A. Shop Assembly:

1. Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation:
 - a. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - b. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - c. Form exposed work with accurate angles and surfaces and straight edges.
 - d. Weld corners and seams continuously to comply with the following:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove welding flux immediately.
 - 4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 - f. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - g. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - h. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

- i. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
 - j. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.
- 2. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to framing and supports for elevator hoistway beams, elevator sills, overhead lobby door frames, sliding doors, countertop and vanities, ceiling hung toilet compartments, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
 - a. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1) Fabricate units from slotted channel framing where indicated.
 - 2) Furnish inserts for units installed after concrete is placed.
 - b. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

2.5 BOLLARDS

- A. Door Device Mounting Bollard:
 - 1. Description: Mounting post for card reader and door activation button:
 - 2. Basis of Design: "ADA-Stainless-Bollard-48x5RxP" as manufactured by Pedestal PRO.
 - 3. Material: Stainless steel.
 - 4. Finish: Brushed.
- B. Pipe Bollards:
 - 1. Fabricate metal bollards from Schedule 40 steel pipe or 1/4 inch (6.4 mm) wall thickness rectangular steel tubing.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
 - 4. Where bollards are to be installed on structural slab or existing paving:
 - a. Fabricate bollards with 3/8 inch (9.5 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.
 - b. Where bollards are anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
 - 5. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4 inch (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to the following:
 - 1. Loose steel lintels.
- B. Fabrication, General:
 - 1. Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated.

2. Fabricate to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items:
3. Cut, drill, and tap units to receive hardware, hangers, and similar items.
4. Fabricate units from slotted channel framing where indicated.
5. Provide inserts for units installed after concrete is placed.

2.7 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation from Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

2.8 FINISHES

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

2.10 STAINLESS STEEL FINISHES

- A. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing:
 1. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
 - a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming:
 1. Prepare surfaces to comply with requirements indicated below:
 - a. Exterior items: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
 - b. Items indicated to receive zinc-rich primer: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
 - c. Items indicated to receive primers specified in Section 09 96 00 - High-Performance Coatings: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."

- d. Other items: SSPC SP3, "Power Tool Cleaning."
- E. Shop Priming:
 - 1. Apply shop primer to comply with SSPC PA1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting:
 - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

3.2 FIELD CONDITIONS

- A. Field Measurements:
 - 1. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication:
 - a. Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - b. Provide allowance for trimming and fitting at site.

3.3 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack, and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding:
 - 1. Comply with the following requirements:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection:

1. Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - a. Cast aluminum: Heavy coat of bituminous paint.
 - b. Extruded aluminum: Two (2) coats of clear lacquer.

3.4 INSTALLING BOLLARDS

- A. Fill metal capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.
- B. Install plumb.
- C. Backfill as indicated on Drawings.

3.5 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.

3.6 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.
- B. Maximum Offset from True Alignment: 1/4 inch (6mm).
- C. Maximum Out of Position: 1/4 inch (6mm).

3.7 ADJUSTING AND CLEANING

- A. Touchup Painting:
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:
 - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 - Painting and Coating.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 75 00 - DECORATIVE FORMED METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Edge-protection and transition profiles for floors.
 - 2. Finishing and edge-protection profiles for walls and countertops.
 - 3. Decorative corner trim.
 - 4. Decorative reveals.
 - 5. Decorative sheet metal.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies.
 - 2. Section 09 65 00 - Resilient Flooring.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.
- H. ASTM B247M - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings (Metric); 2020.
- I. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Package for protection against transportation damage.
 - 2. Provide markings to identify components consistently with drawings.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation.
 - 3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Flooring Transition, Type 2 (MT-2):
 - 1. Basis of Design Product: RENO-RAMP manufactured by Schluter.
 - 2. Description: anodized aluminum profile with textured, sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Material and Finish: AE - Satin Anodized Aluminum.
 - 4. Height: Height as required.
 - 5. Ramp Length: As required to maintain a slope not greater than one unit vertically in two units horizontally.
- B. Flooring Transition, Type 1 (MT-1):
 - 1. Basis of Design Product: RENO-T manufactured by Schluter.
 - 2. Description: T-shaped profile with 1/16 inch (1 mm) thick beveled exposed surface and 11/32 inch (9 mm) tall integrated vertical anchoring leg.
 - 3. Material and Finish: AE - Satin Anodized Aluminum.
 - 4. Width: 17/32 inch.

2.3 FINISHING AND EDGE-PROTECTION PROFILES

- A. Decorative Trim, Type 1 (DT-1):
 - 1. Basis of Design Product: "JDM-625 manufactured by Fry Reglet.
 - 2. Description: "J" shaped trim for use at the perimeter of panel materials.
 - 3. Size:
 - a. Depth: 5/8 inch (16 mm).
 - b. Return: 3/16 inch (5 mm).
 - 4. Material: Aluminum.
 - 5. Finish: Clear anodized.

2.4 DECORATIVE CORNER TRIM

- A. Corner Trim, Type 1 (CT-1):
 - 1. Basis of Design Product: DMCT-375 manufactured by Fry Reglet.
 - 2. Description: Corner trim with 3/8 inch (10 mm) exposure on each side.
 - 3. Material and Finish: Powder Coated.

2.5 DECORATIVE REVEALS

- A. Decorative Reveal, Type 1 (DR-1):
 - 1. Basis of Design Product: DRM-625-375, Non-Vented manufactured by Fry Reglet.
 - 2. Description: Decorative reveal.
 - a. Reveal Depth: 5/8 inch (16 mm).
 - b. Reveal Width: 3/8 inch (10 mm).
 - 3. Material: Stainless steel.
 - a. Finish: Buffed Stain Stainless Steel.
- B. Decorative Reveal, F-Type (DR-F):
 - 1. Basis of Design Product: DRMF-625-50, Non-Vented manufactured by Fry Reglet.
 - 2. Description: Decorative "F" reveal.
 - a. Reveal Depth: 1/2 inch (13 mm).
 - b. Reveal Height: 3/8 inch.
 - 3. Material: Aluminum.
 - a. Finish: Mill.

2.6 DECORATIVE SHEET METAL

- A. Decorative Sheet Metal, (DP1):
 - 1. Description: Decroative infill panel.
 - 2. Material: Aluminum.
 - a. Finish: As selected by Architect.
 - 3. Installation: As indicated on Drawings.

2.7 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B209/B209M.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.
 - 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
 - 4. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
 - 5. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
 - 6. Die and Hand Forgings: ASTM B247/ASTM B247M, Alloy 6061-T6.
 - 7. Castings: ASTM B26/B26M, Alloy A356.0-T6.
- B. Factory Finish:
 - 1. Color Anodic Coating: AA-M12C22A44, AAMA 611, Architectural Class I.
 - 2. Clear Anodic Coating: AA-M12C22A41, AAMA 611, Architectural Class I Clear Anodic Coating.

PART 3 EXECUTION

3.1 APPLICATION

- A. Consult manufacturer's current technical literature for proper design and installation instructions.

END OF SECTION 05 75 00

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rough carpentry, light hardware, and miscellaneous items of work not included in another Section.
 - 2. Structural wood supports, grounds, backing, and blocking required for millwork and casework items that are an integral part of wall, floor, and/or ceiling construction.
 - 3. Plywood sheathing.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 07 21 00 - Thermal Insulation.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength; 2021.
- B. WCLIB (GR) - WCLB Standard Grading Rules for West Coast & Imported Softwood Lumber No.18; 2024.

1.4 REFERENCES

- A. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
 - 1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
 - 2. Grading Rules for Western Lumber of the Western Wood Products Association.
 - 3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
 - 4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
 - 5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

1.5 QUALITY ASSURANCE

- A. Lumber and plywood shall be grade or quality marked by WWPA, WCLIB, APA, AWPB, or by other grading and inspection agencies acceptable to the Architect. Grade marks shall include the designation "S-DRY"(or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store kiln dried materials in enclosed areas, protected from moisture and separated from contact with concrete or soil.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
- B. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
 - 1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
 - 2. Grading Rules for Western Lumber of the Western Wood Products Association.
 - 3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
 - 4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
 - 5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

2.3 MATERIALS

- A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth, as usage requires.
- B. Stud Framing, 2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm):
 - 1. Species: Allowed under referenced grading rules. Species: Douglas Fir-Larch.
 - 2. Grade: No. 2.
 - 3. Products:
 - a. Roseburg Forest Products; Stud Length Lumber: www.roseburg.com/#sle.
- C. Lumber Not Otherwise Specified or Noted:
 - 1. Douglas fir or larch, graded and grademarked, according to Reference Standard 1.02 A or B, #1 grade:
 - a. Boards: Construction grade.
- D. Plywood for Walls and Roofs; as Indicated on Drawings:
 - 1. Unless glue type is otherwise specified, exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times.
- E. Rough Hardware:
 - 1. Nails, spikes, bolts, screws, tacks, and framing connectors of standard manufacture as required. Hot dip galvanize items exposed to moisture or to exterior and those items that are in contact with wood pressure treated with waterborne salts:
 - a. Bolts and Nuts: ASTM A307, Grade A.
 - b. Lag Bolts: Fed. Spec. FF-B-561. Pre-drill per CBC.
 - c. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.
 - d. Joist Hangers and Framing Connectors: Simpson or approved equal, unless otherwise noted.

- e. Power Driven Fasteners: Hilti, Ramset, or approved equal, each use and fastener type subject to prior approval by the Architect.
- F. Pressure Treatment (Decay and Termite Prevention):
 - 1. Pressure treat for decay and termite prevention, Douglas fir or larch wood materials that are embedded in or set against concrete.
 - 2. Treat in accordance with applicable standard
 - 3. Provide with quality mark per applicable standard.
 - 4. Treat with any of the following processes at the Contractor's option. Creosote type preservatives are not permitted:
 - a. Penta in an LPG carrier (Cellon) or Penta in Hydrocarbon Solvent-Type D (Dow Process) AWPB LP-4 quality marked.
 - b. Ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) in a water carrier (AWPB LP-2 quality marked).
 - c. Disodium Octaborate Tetrahydrate (DOT) such as Advance Guard/Hi-bor by Osmose, Inc.
 - d. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19 percent after treatment.
 - 5. Where possible, precut material before treatment.
 - 6. Holes and cutoffs and handling and storage shall be in accordance with AWWA M-4.
 - 7. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating) where required by ICC reports.
- G. Framing Connectors: Simpson Strong Tie Corp., or equal.

2.4 MOISTURE CONTENT

- A. 19 percent maximum for two times thickness and less; 19 percent maximum for thickness greater than two times and less than four times; and 22 percent maximum for thickness greater than four times.

2.5 SIZES

- A. Surfaced to "DRY" sizes. Sizes noted are nominal unless indicated as net.

2.6 SURFACING

- A. All wood materials exposed in the finished work shall have re-sawn surfaces of clean natural color unless noted or specified otherwise. Concealed framing lumber shall be S4S.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

- A. Framing:
 - 1. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place.
- B. Except as specifically shown on structural drawings, cutting of all wood, etc. is limited to those cuts permitted by applicable Building Code.
- C. Bridging and Blocking:
 - 1. Provide two times blocking at intersections of finished surfaces for adequate bearing and at points where required to support fixtures, cabinets, hardware, and other equipment mounted on walls.
- D. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by code, application of plywood shall be in accordance with recommendations of the American Plywood Association.
- E. Connections and Fastenings:
 - 1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.

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Alamo Colleges District - Northeast Lakeview College
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2. Exercise care in nailing through exposed sheathing and siding and ensure that fasteners penetrate into framing members

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section includes:
 - 1. Wall sheathing.
 - 2. Underlayment.
 - 3. Sheathing joint and penetration treatment.
 - 4. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing.

1.3 REFERENCE STANDARDS

- A. ASME B18.6.1 - Wood Screws (Inch Series); 1981 Edition, 1981.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.
- E. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.
- H. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).
- I. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- J. ASTM D5516 - Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures; 2018.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- M. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.
- N. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.
- O. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- P. PS 1 - Structural Plywood; 2023.
- Q. PS 2 - Performance Standard for Wood Structural Panels; 2018.

1.4 SUBMITTALS

- A. Product Data:

1. Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:
 - a. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - b. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - c. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
 - d. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

- A. Fire Test Response Characteristics:
 1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Fire Resistance Ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Preservative Treated Plywood:
 - a. Georgia Pacific: www.gp.com.
 2. Wall Sheathing:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Georgia Pacific: www.gp.com.
 - c. National Gypsum Company: www.nationalgypsum.com.
 - d. United States Gypsum Co.: www.usg.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- C. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 MATERIALS

- A. Plywood: DOC PS 1 .
- B. Oriented Strand Board: DOC PS 2.
- C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground:
 - 1. Preservative chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 WALL SHEATHING

- A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:
 - 1. Basis of Design Products:
 - a. GlasRoc manufactured by CertainTeed Corporation.
 - b. Dens-Glass manufactured by Georgia Pacific.
 - c. Gold Bond eXP manufactured by National Gypsum Company: .
 - d. Securock manufactured by United States Gypsum Co.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
 - 3. Size: 4 by 8 feet (1,220 by 2,440 mm) for vertical installation.

2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged Single Floor Panels:
 - 1. Span Rating: Not less than 20 inches (508 mm) o.c.
 - 2. Nominal Thickness: Not less than 1 inch (25 mm).
 - 3. Edge Detail: Tongue and groove.
 - 4. Surface Finish: Fully sanded face.
- B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6 mm) over smooth subfloors and not less than 3/8 inch (10 mm) over board or uneven subfloors.
- C. Sound Deadening Board: Class C Fire Rated, Molded, Recycled Post-Consumer Paper, Cellulose Fiber Structural Panel:
 - 1. Density: 26 to 28 pcf (416 to 448 kg/cu. m) tested in accordance with ASTM C209.
 - 2. Tensile strength when tested in accordance with ASTM C209:
 - a. Parallel: 450 to 700 psi (3100 to 4830 kPa).
 - b. Transverse: 750 to 1000 psi (5.1 to 6.9 kPa).
 - 3. Hardness (Janka Ball): 230 pounds (104 kg) tested in accordance with ASTM D1037.
 - 4. Water absorption by volume, when tested in accordance with ASTM C209:
 - a. Two-hour immersion: Maximum seven percent (7%).
 - 5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
 - 6. Noise reduction coefficient (NCR): 0.20.
 - 7. Flame spread: Maximum 75 tested in accordance with ASTM E84 Class C.

8. Thickness: 3/4 inch (19 mm).

2.6 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667/F1667M.
- C. Power Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
 - 1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
 - a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

2.7 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass Mat Gypsum Sheathing:
 - 1. Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners:
 - a. Sheathing tape: Self-adhering glass fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in-service use.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than 3 support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-216 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (10 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4 inch (6 mm) gap where they abut masonry or similar materials that retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation:
 - 1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
 - a. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (10 mm) from edges and ends of boards.
- D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

END OF SECTION 06 16 00

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SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Providing all finish carpentry items including, but not limited to:
 - a. Finish carpentry.
 - b. Millwork and cabinetry.
 - c. Plastic laminate.
 - d. Casework hardware.
 - e. Miscellaneous millwork.
 - 2. Installation of:
 - a. Finish hardware.
 - b. Plastic laminate faced wood doors.
 - c. Countertops.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 12 36 00 - Countertops.
 - 3. Section 13 34 23.14 - Fabricated Classroom Buildings.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- G. BHMA A156.9 - Cabinet Hardware; 2020.
- H. KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; 2017.
- I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's preprinted product information for all hardware proposed on the Project.
 - 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
 - 1. Indicate size, material, and finish.
 - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim, and other pertinent data for each unit.
- C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to WI "Custom" Grade guidelines or better.

- D. Samples: Two each, 6 inches by 6 inches by 3/4 inch (152 mm by 152 mm by 19 mm) sample of specified particleboard core with grade stamp for use as verification of installed product.
- E. Closeout:
 - 1. Record drawings: Indicate revisions to original Drawings and shop drawings.
 - 2. Manufacturer contact names, addresses, and phone numbers.
 - 3. Finish material schedule: Names and color numbers of laminates and stains.
 - 4. Keys: Provide additional master key for each room and additional locksets totaling one percent (1%) of total Project for attic stock.

1.5 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with WI "Architectural Woodwork Standards," Custom Grade, except where specification exceeds those standards the more stringent shall govern.
- B. Fabricate millwork and cabinetry in accordance with KCMA A161.1, NEMA LD 3, and general static load testing performed and certified by an independent testing agency covering the following areas of product performance, with these minimum results:
 - 1. Base cabinet construction/racking test: 800 pounds (363 kg).
 - 2. Cabinet front joint loading test: 425 pounds (193 kg).
 - 3. Wall cabinet static load test: 2,000 pounds (907 kg).
 - 4. Drawer front joint loading test: 600 pounds (272 kg).
 - 5. Drawer construction/static load test: 750 pounds (340 kg).
 - 6. Cabinet adjustable shelf support device/static load test: 300 pounds (136 kg).
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.6 QUALITY ASSURANCE

- A. Manufacturers and fabricators must be Woodwork Institute listed Accredited Millwork Companies, current roster.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- C. Installer Qualifications: Licensee of WI's Certified Compliance Program.
- D. Quality Standard:
 - 1. Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements:
 - a. Before delivery to jobsite, millwork supplier:
 - 1) Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this Project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
 - 2) Non-licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this Project and certifying that these products and their installation will fully meet requirements of grade or grades specified.
 - b. Each elevation of casework and each countertop shall bear certified compliance label.
 - c. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.
- E. Pre-Installation Conference:
 - 1. Refer to Section 01 31 00 - Project Management and Coordination.

1.7 WARRANTY

- A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 - 1. Rough or difficult operation, or loose or missing parts.
 - 2. Delamination of surfaces.
 - 3. Noticeable deterioration of finish.
 - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Plastic Laminate:
 - a. Abet Laminati, Inc: abetlaminati.com.
 - b. Formica Corporation: www.formica.com.
 - c. Panolam Industries International Inc: panolam.com/hpl-high-pressure-laminate.
 - d. Wilsonart, LLC: www.wilsonart.com.
 - 2. Millwork Fabricators:
 - a. Woodwork Institute listed Accredited Millwork Companies, current roster, this shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project.
 - 3. Hardware:
 - a. Doug Mockett & Company, Inc.: www.mockett.com.
 - b. Grass America: www.grassusa.com.
 - c. Hafele North America Co.: www.hafele.com.
 - d. Julius Blum & Co., Inc.: www.juliusblum.com.
 - e. Knappe & Vogt: www.knappeandvogt.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.

- d. Steel: AWS D1.1/D1.1M.

2.3 MILLWORK MATERIALS

A. Plastic Laminate:

1. High-pressure decorative laminate complying with NEMA LD 3, and the following requirements:
 - a. Exterior Color Selection Available:
 - 1) PL-1: Plastic Laminate Type 1.
 - (a) Manufacturer: Wilsonart, LLC.
 - (b) Color: Brazilwood 7946-38.
 - (c) Finish: Fine Velvet.
 - (d) Location: As indicated on Drawings.
 - 2) If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
2. Laminate Grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch (0.7 mm) thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch (0.7 mm) thick nominal)
 - c. Cabinet Liner: CL20 (0.020 inch (0.5 mm) nominal), white.
 - d. Work surfaces and countertops: GP50 (0.050 inch (1.3 mm) thick nominal) with BK20 (0.20 inch (5.1 mm) thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch (1.1 mm) nominal) with nominally balanced backer sheet.
3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
4. Pressure Fused Laminate:
 - a. NEMA LD 3 VGL, and NEMA LD 3 CLS, melamine resin impregnated, 120-gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

B. Core Material:

1. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
2. Medium-density fiberboard: ANSI A208.2, Grade MD.
3. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
4. Water resistant treated plywood shall have 24 hour thickness swell factor of 5 percent or less and 24 hour water absorption factor of 10 percent or less; P.S. 51, Type II or better.
5. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet Backs, Drawer Body, and Drawer Bottoms: 1/2 inch (13 mm) particleboard.
 - b. Door and Drawer Face, Base, Wall, and Tall Cabinet Tops and Bottoms, Cabinet Sides, Drawer Spreaders, Cabinet Back Rear Hangstrips, Structural Dividers, and Exposed Cabinet Backs: 3/4 inch (19 mm) particleboard.
 - c. Work Surfaces and Countertops: Minimum 1 inch (25 mm) particleboard or plywood. Use water resistant treated plywood core at counters with sinks.
 - d. Shelves: 3/4 inch (19 mm) particleboard core for 30 inches (762 mm) long or less, 1 inch (25 mm) thick particleboard core for more than 30 inches (762 mm) long; 14 inch (356 mm) deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches (914 mm) long.

- e. Cabinet Toe-Base: 3/4 inch (19 mm) plywood. No particleboard within 3 inches (76 mm) of floor.
- C. Countertops:
 - 1. Refer to Section 12 36 00 - Countertops.
- D. Toe Spaces:
 - 1. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- E. End Panels and Filler Strips:
 - 1. Match adjacent case-piece.
- F. Edging:
 - 1. Provide the following in accordance with "Edging Locations:"
 - a. Plastic Laminate: Refer to Plastic Laminate in this Section.
 - 2. Edging Locations:
 - a. Cabinet body edge, including door/drawer front spacer rail:
 - 1) Plastic Laminate to match cabinet body face.
 - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body:
 - 1) Plastic Laminate to match cabinet body face.
 - c. Door/drawer-front edging:
 - 1) Plastic Laminate to match door/drawer face.
- G. Wood Base:
 - 1. Material: Construction grade light framing, pressure treated.
 - 2. Size: As indicated on Drawings.Finish: [____].
 - 3. Finish: As selected by Architect.

2.4 CABINET HARDWARE

- A. All hardware shall meet BHMA A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner:
- B. Hinges:
 - 1. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
 - a. Provide 170 degree minimum opening capabilities. For end doors perpendicular to walls, provide 90 degree type.
 - b. For doors 32 inches (813 mm) high or less, provide 2 pair of hinges, add 1/2 pair for every additional 20 inches (508 mm).
 - c. Basis of Design Products:
 - 1) No. MD61-253-Z00 manufactured by Grass America.
 - 2) No. 326.05 manufactured by Hafele North America Co.
 - 3) No. B71650 manufactured by Julius Blum, Inc.
 - 2. One pair per door to 48 inches (1,219 mm) height. One and one-half pair over 48 inches (1,219 mm) in height. Hinge shall accommodate 13/16 inch (21 mm) thick laminated door and allow 270-degree swing.
 - 3. Finish: US26D.
- C. Pulls:
 - 1. Tab:
 - a. Basis of Design: DP3 Series manufactured by Doug Mockett & Company, Inc.
 - b. Back mounted, solid metal.
 - c. Size:
 - 1) Projection: 1-1/2 inches (38 mm).
 - 2) Length: 4 inches (102 mm).
 - d. Finish: Satin Chrome.

2.5 SPECIALTY ITEMS

- A. Grommets:
 - 1. Basis of Design Product:
 - a. Model No. EDP3 manufactured by Doug Mockett & Company, Inc.
 - 2. Size: 2-1/2 inch (64 mm) diameter with Flip-Top tab in cap.
 - 3. Colors: As selected by the Architect from manufacturer's available colors.
 - 4. Number/location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.

2.6 MISCELLANEOUS

- A. Utility Shelving: WI "Economy" grade.

2.7 MILLWORK FABRICATION

- A. Use the WI Custom Grade woodwork classification unless noted elsewhere complying with referenced quality standard.
- B. Fabricate casework and related products to dimensions, profiles, and details shown on Drawings. Fabricate casework square, plumb, and true.
- C. Detailed Requirements for Cabinet Construction:
 - 1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor.
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch (6 mm) from face of finished end for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inch (914 mm), bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inches (32 mm) on center.
 - 4. Cabinet Backs:
 - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
 - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two at base, two at wall, and three at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on Drawings.
 - 5. Exposed end corner and face frame attachment:
 - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
 - 6. Door and Drawer Fronts:
 - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
 - b. Where indicated, provide stile and rail doors with full 1/4 inch (6 mm) plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.

- c. Where indicated, frameless sliding glass doors shall be 1/4 inch (6 mm) thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- D. Drawers:
 - 1. Drawer fronts: Apply to separate drawer body component sub-front.
 - 2. Drawer sides: Doweled to receive front and back, glued under pressure, machine squared.
 - 3. Drawer bottom: Set into front and sides, 1/4 inch (6 mm) deep groove with minimum 3/8 inch (19 mm) standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch (13 mm) by 4 inches (102 mm) front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches (610 mm), two at 36 inches (914 mm), and over.
 - 4. Paper Storage Drawers: Fitted with full width hood at back.
 - 5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- E. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- F. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- G. Typical Desk or Counter Height at Knee Space Locations: 30 inches (762 mm) A.F.F.

PART 3 EXECUTION

3.1 JOB CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week:
 - a. Manufacturer/supplier shall advise the Contractor of temperature and humidity requirements for architectural casework installation areas.
 - b. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

3.2 COORDINATION

- A. Coordinate the work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22 or as indicated on Drawings.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

3.3 MILLWORK INSTALLATION

- A. Positioning: Place approximately level, plumb, and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws, and glue.
- E. Install simulated wood trim in locations shown on Drawings and in accordance with manufacturer's instructions.

3.4 EXISTING DOOR LAMINATE RESURFACING

- A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.

- B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well-ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.
- C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.
- D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.
- E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.
- F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer to achieve full adhesion to maintain warranty. Trim with recommended tools.
- G. Apply laminate to door faces and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.
- H. Coordinate hardware and vision lite cutouts with work of other Sections.

3.5 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at their expense.
- C. Provide clean, properly sized, and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork the Contractor shall be responsible for hardware on millwork.

3.6 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

- A. Protect all doors during handling.
- B. Install doors in accordance with manufacturer's instructions.
- C. Install and adjust doors for smooth, quiet operation.
- D. Refer to Section 08 71 00 - Door Hardware where applicable.

END OF SECTION 06 20 00

SECTION 07 05 43 - CLADDING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cladding support systems, directly attached to substrates.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete.
 - 2. Section 04 20 00 - Unit Masonry.
 - 3. Section 05 40 00 - Cold Formed Metal Framing.
 - 4. Section 06 10 00 - Rough Carpentry.
 - 5. Section 07 21 00 - Thermal Insulation.
 - 6. Section 07 27 26 - Fluid-Applied Membrane Air Barriers.
 - 7. Section 07 42 13 - Metal Wall Panels.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Zn-Al-Mg: Zinc-Aluminum-Magnesium.

1.4 DEFINITIONS

- A. Continuous Insulation: As defined by ASHRAE Std 90.1 I-P.

1.5 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASTM A1046/A1046M - Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate cladding support system manufacturer's requirements with requirements of exterior structural wall assemblies.
- B. Preinstallation Meetings:
 - 1. Schedule meeting to occur after final approval of submittals by the Architect.
 - 2. Agenda: Review exterior structural wall assembly requirements and cladding fastening requirements.
 - 3. Required Attendees: The Contractor, cladding support system subcontractors and cladding subcontractors.

4. Invited Attendees: the Owner, the Owner's Designated Representative (ODR), the Owner's observation services provider, and the Architect.

1.7 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published descriptive data, including product attributes.
 1. Include data for cladding support system.
- C. Shop Drawings: For each cladding support system; indicate:
 1. Sections: Include column centers, elevations, and dimensions; indicate locations of system components, component spacings, and wall fasteners.
 - a. Drawing Scale: 1/8 inch to 1 foot (1:100), minimum.
 2. Details: Connection details between cladding support systems and substrates; indicate fastener size and spacing.
 - a. Drawing Scale: 1-1/2 inches to 1 foot (1:10), minimum.
- D. Certificate: Certify cladding support systems of this section meet or exceed specified design criteria.
- E. Test Reports: Submit test reports for each type of cladding support system performed by qualified testing agency for manufacturer.
- F. Specimen warranty.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.
- C. Documents at Project Site: Maintain at project site one copy of manufacturer's installation instructions and shop drawings.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver products to project site in wrapped, protected, unbroken packaging with product identification labeling.
- C. Store products under cover and elevated above grade.
- D. Handle products without damaging; prevent bending, warping, and twisting to surfaces, edges, or corners.

1.10 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty against structural failure of cladding support system. Complete forms in Owner's name and register with manufacturer.
- C. Manufacturer's Special Warranty: Provide 10-year warranty for cladding support system components, including structural failure of components, commencing on Date of Substantial Completion. Complete forms in the Owner's name and register with warrantor.
- D. Installer Warranty: Provide 2-year warranty against installation defects commencing on Date of Substantial Completion. Complete forms in the Owner's name and register with installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
 - 1. Advanced Architectural Products, LLC: www.smartcisystems.com.
 - 2. Cladiator: www.cladiator.com.
 - 3. Hohmann & Barnard, Inc: www.h-b.com.
 - 4. Knight Wall Systems: www.knightwallsystems.com.
 - 5. Northern Facades: www.northernfacades.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- C. Source Limitations: Provide complete cladding support system including wall fasteners and wall anchors from single manufacturer.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 BASIS OF DESIGN

- A. HB RS EZclad Rainscreen Support System manufactured by Hohmann & Barnard, Inc.

2.4 PERFORMANCE CRITERIA

- A. Surface Burning Characteristics: Provide cladding support systems with a flame spread index (FSI) of 25 or less, and a smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84 or UL 723.
- B. Fire Propagation Requirements of Exterior Wall Assemblies: Tested in accordance with, and comply with, the acceptance criteria of NFPA 285.

2.5 DESIGN CRITERIA

- A. Refer to Section 01 40 00 - Quality Requirements for additional information.
- B. Thermal Performance Design Services: Provide the Contractor's design-related professional services for thermal performance design of cladding support systems:
 - 1. Design Criteria: Provide cladding support systems that, when combined with thermal performance of continuous insulation and other exterior wall assembly components, provide building envelope wall assemblies that meet minimum energy efficiency requirements of ASHRAE Std 90.1 I-P.

2.6 EXTERIOR WALL ASSEMBLIES WITH CLADDING SUPPORT SYSTEMS

- A. Cladding: Refer to Section 07 42 13 - Metal Wall Panels.
- B. Depth of Air-Gap Cavity: As indicated on Drawings.
- C. Cladding Support System Applications:
 - 1. Direct-attached-to-substrate cladding support systems.
- D. Exterior Continuous Thermal Insulation:
 - 1. Refer to Section 07 21 00 - Thermal Insulation.
 - 2. Depth of Insulation: As indicated on Drawings.
- E. Water-Resistive Barriers: Refer to Section 07 27 26 - Fluid Applied Air Barrier Systems.

- F. Vapor Retarders: Refer to Section 07 27 26 - Fluid-Applied Air Barrier Systems.
- G. Air Barriers: Refer to Section 07 27 26 - Fluid-Applied Air Barrier Systems.
- H. Sheathing: Refer to Section 06 16 00 - Sheathing.
- I. Exterior Structural Wall Assemblies: Refer to Sections 03 30 00 - Cast-in-Place Concrete, 04 20 00 - Unit Masonry, 05 40 00 - Cold Formed Metal Framing, and 06 10 00 - Rough Carpentry.

2.7 CLADDING SUPPORT SYSTEMS, DIRECTLY ATTACHED TO SUBSTRATE

- A. Perforated Metal, Hat-Shaped, Cladding Attachment Rails:
 - 1. Basis of Design Products:
 - a. PanelRail manufactured by Knight Wall Systems.
 - 2. Description: Square-shaped hat channels perforated with vent holes; hat-shape faces outward; flanges with stiffening lips and fastener attachment holes.
 - 3. Attachments to Substrate: Manufacturers recommended anchors fasten rails to substrates through attachment holes of flanges.
 - 4. Applications:
 - a. Direct-attached-to-substrate cladding support systems; attaches directly to exterior structural wall assemblies.
 - b. Secondary system in dual-system cladding support systems; attached to and installed outboard of primary cladding support system.
 - 5. Material: Zn-Al-Mg-coated steel sheet.
 - 6. Depth: 3/4 inch (19 mm).
 - 7. Thickness: 18 gauge, 0.048 inch (1.2 mm).
 - 8. Flange Width: Two equal flanges, each 1 inch (25 mm) wide, nominal.
 - 9. Face Width and Total Width Including Flanges:
 - a. Face Width: In accordance with Contractor -provided structural design.
 - 10. Orientation in Direct-Attached-to-Substrate Applications: As indicated on Drawings.
 - 11. Spacing: In accordance with Contractor -provided structural design.

2.8 MATERIALS

- A. Zinc-Aluminum-Magnesium (Zn-Al-Mg)-Coated Steel Sheet:
 - 1. ASTM A1046/A1046M, Designation SS, Grade 50, Class 2; Coating Designation ZM40.
 - 2. Thickness: 18 gauge, 0.048 inch (1.2 mm).
 - 3. Finish: Superior performing organic coatings complying with AAMA 2605, multiple coats, thermally cured polyvinylidene fluoride system; finish one side only.

2.9 FABRICATION

- A. Shop fabricate to greatest extent possible.

2.10 ACCESSORIES

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Verify substrates comply with Contract Documents, including specified tolerances, and are ready to receive work of this section.
 - 2. Verify air barrier, wall flashing, and rigid insulation work comply with Contract Documents.
- B. Do not commence installation until non-compliant conditions have been corrected.

3.2 PREPARATION

- A. Protection of In-Place Conditions: Protect air barrier work from damage.
- B. Surface Preparation:

1. Prepare substrate surfaces using methods in accordance with cladding support system manufacturer's written instructions.

3.3 INSTALLATION

- A. Installation of Cladding Support System Substrates.
- B. Install cladding support systems in accordance with Contractor -provided structural design.
- C. Installation of Wall Anchors in Concrete Wall Substrates: Install anchors in accordance with Contractor -provided structural design.
- D. Installation of Wall Fasteners in Cold-Formed Metal Framing Wall Substrates: Install fasteners in accordance with Contractor -provided structural design.
- E. Installation of Secondary System Fasteners to Primary Cladding System Substrates: Install fasteners in accordance with Contractor -provided structural design.

3.4 TOLERANCES

- A. Install cladding support systems plumb with noncumulative maximum variation of:
 1. 1/4 inch in 20 feet (1 mm in 1 m).
- B. Install cladding support systems level with noncumulative maximum variation of:
 1. 1/4 inch in 20 feet (1 mm in 1 m).

3.5 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Manufacturer Services: Provide services of manufacturer's field representative to inspect installation of cladding support systems.

3.6 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.

3.7 PROTECTION

- A. Protect installed cladding support systems from subsequent construction operations.

END OF SECTION 07 05 43

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Extruded polystyrene foam plastic board.
 - 2. Polyisocyanurate foam plastic board.
 - 3. Glass mineral fiber blanket.
 - 4. Rock mineral wool blanket.
 - 5. Rock mineral wool board.
 - 6. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCE STANDARDS

- A. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations; 2018.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- G. ASTM C727 - Standard Practice for Installation and Use of Reflective Insulation in Building Constructions; 2019.
- H. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2025.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C1104/C1104M - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2019.
- K. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
- L. ASTM C1321 - Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction; 2015.
- M. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.
- N. ASTM C1744 - Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Commercial/Industrial Building Construction; 2019.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

- P. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- Q. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.
- R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Technical data and installation instructions for each type of insulation product specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization
 - a. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread Index: Maximum 25.
 - 2) Smoke Developed Index: Maximum 450.
 - b. Fire Resistance Ratings: Per ASTM E119.
 - c. Combustion Characteristics: Non-combustable per ASTM E136.
 - 2. Underwriter's Laboratories UL 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of work.
 - 1. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
- C. Environmental Requirements:
 - 1. Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected:
 - a. Wherever possible, provide boards from manufacturers who recycle insulation materials.
 - 2. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect Foam Plastic Board Insulation:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.7 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence work to ensure fireproofing and firestop materials are in place before beginning work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. CertainTeed Corporation: www.certainteed.com/building-insulation.
 2. DuPont de Nemours, Inc.: www.dupont.com.
 3. Hunter Panels: www.hunterpanels.com.
 4. Johns Manville; a Berkshire Hathaway company: www.jm.com.
 5. Kingspan Group: www.kingspan.com/us/en.
 6. Knauf Insulation: www.knaufinsulation.com.
 7. Owens Corning: www.owenscorning.com/en-us/insulation/commercial.
 8. Rmax, a subsidiary of the Sika Corporation: www.rmax.com.
 9. Rockwool A/S: www.rockwool.com/north-america.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 EXTRUDED POLYSTYRENE FOAM BOARD

- A. Extruded Polystyrene Foam Board: ASTM C578, Type IV.
 1. Basis of Design Products:
 - a. Styrofoam Cavitymate Plus manufactured by DuPont de Nemours, Inc.
 - b. GreenGuard manufactured by Kingspan Group.
 - c. Foamular CW25 manufactured by Owens Corning.

2.4 POLYISOCYANURATE FOAM PLASTIC BOARD

- A. Polyisocyanurate Board, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
 1. Basis of Design Products:
 - a. Thermax manufactured by DuPont de Nemours, Inc.
 - b. Xci manufactured by Hunter Panels.
 - c. ECOMAXci manufactured by Rmax, Inc.
 2. Fire Propagation Characteristics: Pass NFPA 285 testing as part of an approved assembly.

2.5 GLASS MINERAL FIBER INSULATION

- A. Glass Mineral Fiber Batt, Unfaced: ASTM C665, Type I (unfaced); with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

1. Basis of Design Products:
 - a. CertaPro manufactured by CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - d. PINK Next Gen Fiberglas manufactured by Owens Corning.
- B. Glass Mineral Fiber Batt, Kraft Faced: ASTM C665 , Type II (nonreflective faced), Class A (faced surface with a flame spread index of 25 or less); Category 1 (membrane is a vapor barrier).
 1. Basis of Design Products:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - d. PINK Next Gen Fiberglas manufactured by Owens Corning.
- C. Glass Mineral Fiber Board:
 1. Basis of Design Products:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Earthwool manufactured by Knauf Insulation.
 - d. Fiberglas 700 Series Board manufactured by Owens Corning.
 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
 3. Thermal Resistance:
 - a. 2" and greater R value/1 inch at 75 °F: 4.3 h ft² °F/Btu per ASTM C518.
 4. Water Vapor Permeance: 27.2 Perm minimum.
 5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
 6. Fungi Resistance: Zero mold growth per ASTM C1338.
 7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.6 ROCK MINERAL FIBER INSULATION

- A. Rock Mineral Fiber Blanket: ASTM C665, Type I, complying with ASTM E136 smoke developed and flame spread of 0.
 1. Basis of Design Products:
 - a. Thermafiber UltraBatt manufactured by Owens Corning.
 - b. ComfortBatt manufactured by Rockwool A/S.
 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke developed: 0.
 3. Thermal Resistance: To ASTM C518.
 4. Density: 2 lbs/cu ft to ASTM C167.
- B. Rock Mineral Fiber Board: ASTM C612, Type IVB.
 1. Basis of Design Products:
 - a. Thermafiber manufactured by Owens Corning.
 - b. CavityRock manufactured by Rockwool A/S.
 2. Fire Performance:

- a. Combustibility: Non-combustible per ASTM E136.
- b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
3. Thermal Resistance:
 - a. 2" and less R value/1 inch at 75 °F: 4.2 h ft² °F/Btu per ASTM C518.
 - b. 2" and greater R value/1 inch at 75 °F: 4.3 h ft² °F/Btu per ASTM C518.
4. Water Vapor Permeance: 27.2 Perm minimum
5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
6. Fungi Resistance: Zero mould growth per ASTM C1338.
7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.7 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.8 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Board and Batt Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
 - 1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Do not seal joints in board insulation. Remove projections that interfere with placement.
 - 2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- C. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 05 00 - Common Work Results for Masonry.
 - 2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.
- D. Framed Construction, Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3 inch (76 mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal framed wall cavities where cavity heights exceed 96 inches (2,438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu ft (40 kg/cu m).
 - b. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- E. Reflective Insulation: Install sheet reflective insulation according to ASTM C727.
 - 1. Install sheet radiant barriers according to ASTM C1744.
 - 2. Install interior radiation control coating system according to ASTM C1321.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial weather barrier assemblies.
 - 2. Weather barrier flashing.
 - 3. Weather barrier accessories.

1.3 DEFINITIONS

- A. Weather Barrier: A combination of materials and accessories that do the following:
 - 1. Prevent the accumulation of water as a water-resistive barrier.
 - 2. Minimize the air leakage into or out of the building envelope as a continuous air barrier.
 - 3. Provide sufficient water vapor transmission to enable drying as a vapor-permeable membrane.
- B. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly.
- C. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope.
- D. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of higher to lower water vapor concentration (higher to lower vapor pressure).
- E. Vapor Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms (575 ng/Pa x s x sq. m) or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E96 per definition in International Building Code. Vapor permeable material permits the passage of moisture vapor through vapor diffusion.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For weather barrier, include data on air and water-vapor permeance based on testing in accordance with referenced standards.
 - 2. Product Data: Including the following information:
 - a. Provide Environmental Product Declarations (EPDs)
 - b. Provide SDS (formerly MSDS), third-party certifications, or product technical data confirming that systems meet or exceed emissions guidelines for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs), as follows:

- 1) Commercial weather barrier complies with California Department of Public Health (CDPH) Standard.
- 2) Adhesives and sealants wet-applied on-site are to meet/exceed VOC content requirements for wet-applied products and comply with SCAQMD Rule 1168.
- 3) Flashing systems comply with SCAQMD Rule 1168 on VOC limits.

- B. Shop Drawings: Show details of weather barrier at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For weather barrier from ICC-ES.
- B. Manufacturer's Instructions: For installation of each product specified.
- C. Qualification Data: For Installer.
- D. Sample Warranty: For manufacturer's warranty.
- E. Sample warranty: For installer's warranty.
- F. Reports: Field test and inspection reports.
- G. Installer's weather barrier manufacturer-training certificate.
- H. Record Drawings: As-built drawings showing changes made during construction

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product.
- B. Manufacturer's Field Service: Register Project with weather barrier manufacturer prior to installation of weather barrier and comply with weather barrier manufacturer's Project registration and observation process.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store near heat source or open flame.

1.8 WARRANTY

Manufacturer's Product Warranty: To repair or replace weather barrier product that fails in materials within specified warranty period.

1. Warranty Period: 10 years from date of installation.

- B. Installer's Warranty: To repair or replace weather barrier that fails due to workmanship within specified warranty period.

1. Warranty Period: 5 years from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain weather barrier assembly components, including weather barrier and associated flashing components from same manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed weather barrier and accessories shall withstand specified wind pressures, liquid water penetration, and water vapor pressures without failure due to defective manufacture of products.

2.3 WEATHER BARRIER

- A. Commercial Building Wrap: ASTM E2357 passed, ABAA (Air Barrier Association of America) evaluated air barrier assembly, and assembly water resistance per ASTM E331; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized for nine-month exposure; and acceptable to authorities having jurisdiction.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - Tyvek CommercialWrap** or equal.
 2. System Description, Single-Layer Weather Barrier: Single-layer weather barrier, including flashing and sealing of penetrations and seams.
 - a. Primary Layer: Commercial building wrap without integral drainage installed closest to building interior.
 3. Drainability: 98 percent or greater when tested in accordance with ASTM E2273.
 4. Air Permeance, Product: Not more than 0.001 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.005 L/s x sq. m at 75 Pa) tested in accordance with ASTM E2178.
 5. Air Permeance, Assembly: Not more than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.2 L/s x sq. m at 75 Pa) when tested in accordance with ASTM E 2357 and evaluated by ABAA.
 6. Water Penetration Resistance, Product: Hydrostatic head resistance greater than 7.7 ft. (2.35 m) in accordance with AATTC 127.
 7. Water Penetration Resistance, Assembly: Assembly wall specimen described in ASTM E2357 to water resistance in accordance with ASTM E331 to 2.86 lbf/sq. ft. (137 Pa).
 8. Water-Vapor Permeance: Not less than 23 perms (1300 ng/Pa x s x sq. m) per ASTM E96/E96M, Desiccant Method (Procedure A) or not less than 28 perms (1600 ng/Pa x s x sq. m) per ASTM E96/E96M, Water Method (Procedure B).
 9. Water-Vapor Permeance: Not less than 30 perms (1700 ng/Pa x s x sq. m) per ASTM E96/E96M, Desiccant Method (Procedure A) or not less than 46 perms (2600 ng/Pa x s x sq. m) per ASTM E96/E96M, Water Method (Procedure B).
 10. Allowable UV Exposure Time: Not less than nine months when tested in accordance with ASTM G155 (Accelerated Weathering).
 11. Flame Propagation Test: Materials and construction shall be as tested in accordance with NFPA 285.
 12. Heat and Visible Smoke Release Rates: Maximum rates in accordance with NFPA 285.
 - a. Peak Heat Release: 13,217 Btu/sq. ft. (150 kW/sq. m).
 - b. Total Heat Release: 1762 Btu/sq. ft. (20 MJ/sq. m)
 - c. Effective Heat of Combustion: 7744 Btu/lb (18 MJ/kg)
 13. Weather barrier system to have a VOC content of 30 g/L or less.

2.4 WEATHER BARRIER FLASHING

- A. Conformable Weather Barrier Flashing: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for seven days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - FlexWrap NF or equal**.
 2. Conformability: Able to create a seamless sill pan extending up the jambs without cuts, patches, or fasteners.
 3. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E331.
 4. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A (without primer use).
 5. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.
- B. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for seven days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - StraightFlash or equal**.
 2. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E331.
 3. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A without primer use.
 4. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.

2.5 WEATHER BARRIER ACCESSORIES

- A. Building-Wrap Tape: as recommended by weather barrier manufacturer for sealing joints and penetrations in commercial building wrap.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - Flashing Tape or equal**.
- B. Closed-Cell Polyurethane Foam Insulation: Low-pressure, low-expansion, single-component polyurethane foam, with maximum flame-spread and smoke-developed indexes of 15 and 25, respectively.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - Great Stuff Pro Window & Door or equal**.
- C. Fasteners
1. Basis-of-Design Product: Subject to compliance with requirements, Provide **Rodenhouse Thermal-Grip Flat Washer Fastener** as required by Manufacturer's system warranty.
- D. Primer for Flashings: Synthetic rubber-based product; spray applied. Strengthen adhesive bond at low temperature applications between weather products such as self-adhered flashing products, commercial building wraps, and common building sheathing materials.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **DuPont - DuPont Adhesive Primer or equal**.
 2. Peel Adhesion Test: Passes in accordance with ASTM D3330, Test Method F, for the following.
 - a. Peel Angles: 0, 25, 72, and 180 degrees.
 - b. Substrates: Concrete masonry units (CMUs), exterior gypsum sheathing, oriented strand board (OSB), aluminum, and vinyl.
 3. Chemical Compatibility: Pass; AAMA 713.

4. Flame Spread Index: 5; ASTM E84.
5. Smoke Development Index: 0; ASTM E84.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements.
- B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.
 1. Verify that rough sill framing for doors and windows is sloped downwards towards the exterior and is level across width of the opening.
- C. Verify that surfaces to receive weather barrier flashing are clean, dry, and free of frost.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Direct water onto an acceptable weather barrier drainage plane with an unobstructed path to exterior of wall.
 1. Provide a drainage path for water intrusion through window and door attachment system that collects at window and door sills and directs water to the exterior or weather barrier.

3.3 COMMERCIAL BUILDING WRAP INSTALLATION

- A. General: Comply with weather barrier manufacturer's written installation guidelines and warranty requirements.
- B. Cover exposed exterior surface of sheathing with weather barrier securely fastened to framing immediately after sheathing is installed.
 1. Maintain continuity of air and water barrier assemblies.
 2. Start weather barrier installation at a building corner, leaving 12 inches (300 mm) of weather barrier extended beyond corner to overlap.
 3. Install weather barrier horizontally starting at lower portion of wall surface.
 4. Provide minimum 6 inches (150 mm) overlap at horizontal- and vertical-wrap seams in a shingle manner to maintain continuous downward drainage plane and air and water barrier.
- C. Seams: Seal seams with building wrap tape per manufacturer's recommended installation instructions.
 1. Shiplap horizontal seams in weather barrier to facilitate proper drainage.
- D. Fasteners: Use weather barrier manufacturer's recommended fasteners to secure weather barrier and install fasteners according to weather barrier manufacturer's installation guidelines.
 1. Do not use temporary fasteners to permanently attach weather barrier.
 2. Do not place fasteners with gasketing washers where weather barrier flashing will be installed.
 3. Install fasteners with gasketing washers through flashing where recommended by manufacturer.
- E. Openings: Completely cover openings with weather barrier, then cut weather barrier membrane to openings in accordance with weather barrier manufacturer's installation guidelines.
 1. Provide head and jamb flaps and seam overlaps to maintain continuous drainage.

2. Repair damage to weather barrier using method recommended by weather barrier manufacturer.
3. Install flashing in accordance with weather barrier manufacturer's installation guidelines.

3.4 WEATHER BARRIER FLASHING INSTALLATION

- A. Installation: Remove wrinkles and bubbles, reposition weather barrier as necessary to produce a uniform, smooth surface.
 1. Ensure that ambient and substrate surface temperatures are acceptable in accordance with manufacturer instructions and recommendations.
 2. Wipe surfaces to remove moisture, dirt, grease and other debris that could interfere with adhesion.
 3. Apply weather barrier manufacturer's recommended primer over concrete, masonry, and glass-mat gypsum wall sheathing substrates to receive weather barrier flashing.
 4. Lap weather barrier flashing a minimum of 2 inches (50 mm) onto weather barrier.
 5. Apply pressure over entire surface using roller or firm hand pressure
- B. Rough Openings: Shiplap flashing with weather barrier in a shingle manner to maintain a continuous downward drainage plane and air and water barrier in accordance with manufacturer's written instructions.
 1. Apply 9-inch- (230-mm) wide conformable weather barrier flashing at door and window sills.
 2. Ensure that sill flashing does not slope to the interior.
 3. Install backer rod in joint between frame of opening product and flashed rough opening on the interior.
 4. Apply sealant or closed-cell polyurethane foam insulation around entire opening/fenestration product to create air seal around interior perimeter of window openings in accordance with weather barrier manufacturer's instructions.
 5. Around door and window openings, apply butyl-based flashing to flaps of weather barrier.
 6. Use strip flashing with wrap cap screws to secure head flap of the windows.
- C. Penetrations: Apply weather barrier manufacturer's recommended weather barrier flashing patches behind fastening plates, such as brick-tie base plates, metal-flashing clips, and metal channels.
 1. Seal weather barrier around each penetration with weather barrier manufacturer's recommended self-adhered flashing product or sealant. Integrate products with flanges into the weather barrier.
- D. Terminations: Provide minimum 2 inches (50 mm) overlap using strip flashing on adjoining roof and base of wall systems to maintain continuous downward drainage plane.
 1. Secure weather barrier with fasteners and weather barrier flashing.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to train installers and observe installations.

3.6 CLEANING

- A. Immediately remove release paper and scrap from work area and dispose of in approved container.

3.7 PROTECTION

- A. Protect installed weather barrier from the following:

1. Damage from cladding, structure, or a component of the structure (for example, window, door, or wall system).
2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.
4. UV exposure in excess of products' stated limits.

END OF SECTION 072500

SECTION 07 46 19 - STEEL SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel siding for exterior walls.

1.2 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Water-resistive barrier.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Siding materials, underlayment, flashings, fasteners and accessories.
 - 3. Dimensions, physical properties, and typical details.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.
- C. Shop Drawings: Indicate layout, methods of attachment, provisions for movement, flashing, trim, edge and field conditions, interface with adjacent materials, locations of cutouts or special shapes, existing construction, and details.
- D. Samples: For each finish product specified, provide two complete sets of color chips representing manufacturer's full range of available colors and patterns, including the following:

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing brand name and manufacturer's identification until ready for installation.
- B. Verify quantities and condition immediately upon receipt; remove damaged materials from site, and coordinate with manufacturer to replace with new materials meeting specified requirements.
- C. Store products off the ground, within manufacturer's temperature and environmental limits, away from moisture, protected from traffic and construction activities, and minimize on-site storage prior to installation.

1.7 FIELD CONDITIONS

- A. Do not install siding when air temperature or relative humidity are outside manufacturer's limits.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide manufacturer's standard lifetime, non-prorated, transferable warranty, including 50 year hail protection warranty.

- C. Manufacturer's warranty on siding and trim accessories finishes to cover the following:

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Steel Siding:
1. ABC Seamless: www.abcseamless.com/#sle.
 2. EDCO Products, Inc: www.edcoproducts.com/#sle.
 3. MAC Architectural Metals, a Cornerstone Building Brands Company:
www.macmetalarchitectural.com/#sle.
 4. Revere Building Products, Inc: www.reverebuildingproducts.com/#sle.

2.2 STEEL SIDING

- A. Type 1, Horizontal Steel Siding: (SS1)
1. Basis-of-Design: Provide PBR by MBCI, Inc.
 2. Factory-formed steel siding.
 3. Material: Precoated steel sheet, 26 gauge, minimum base metal thickness.
 4. Coverage Width: 36 inches.
 5. Finish: As selected by Architect.
- B. Type 1, Horizontal Steel Siding and Soffit: (HSS):
1. Basis-of-Design: Provide Bellara as manufactured by Dri-Design, a Kingspan Company.
 2. Factory-formed steel siding and soffit.
 3. Material: Precoated steel sheet, 24 gauge, minimum base metal thickness.
 4. Length: 12 feet (3.66 m), minimum.
 5. Steel Siding Depth: 9/16 inch overall depth.
 6. Finish: As selected by Architect from manufacturer's full series range.
 7. Pattern: As selected by Architect from manufacturer's full range of available prints.

2.3 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating, and manufacturer's standard panel back coating.

2.4 ACCESSORIES

- A. Fasteners: Hot dipped galvanized; non-staining, of size and strength to securely and rigidly retain the work; prefinished to match siding finish.
- B. Flashing: Siding manufacturer's standard, factory-finished flashing accessories.
- C. Provide coordinating accessories made of same material as required for complete and proper installation whether or not specifically shown on drawings.
1. Starter strip.
 2. Corner post.
 3. J-Channels.
 4. Window and door trim.
 5. Drip cap.
- D. Finish: Shop precoated with manufacturer's standard SMP (silicone-modified polyester) and Polyvinylidene Fluoride (PVDF) coating system.
1. Color: Match adjacent siding or soffit panels.
 2. Print: As selected by Architect from manufacturer's full option range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions before beginning installation.

- B. Verify dimensions and acceptable substrate condition.
- C. Verify water-resistive barrier (WRB) has been properly installed over substrate; see Section 07 25 00.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- E. Do not proceed with installation until unacceptable conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Prepare surfaces as recommended by manufacturer.
- B. Protect surrounding areas and adjacent surfaces during execution of this work.

3.3 INSTALLATION

- A. Install steel siding, soffit, trim, and accessories in accordance with manufacturer's written instructions.
- B. Attach siding using manufacturers recommended fasteners, sealants, and adhesives, allowing for thermal expansion.
- C. Provide concealed fasteners except where approved on shop drawings.
- D. Horizontal Clapboard: Work from base of installation to top; stagger lap joints in horizontal siding in uniform pattern as successive courses of siding are installed.
- E. Install joint sealants to ensure watertight conditions; see Section 07 92 00.
- F. Where dissimilar materials are in contact, prevent galvanic action as recommended by manufacturer.

3.4 CLEANING

- A. Remove grease and oil films, excess joint sealer, handling marks, and other installation debris from steel siding, leaving siding clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to material finishes.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 46 19

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SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiber-cement siding.
 - a. Lap siding.
 - b. Panel siding.
 - c. Plank siding.
 - d. Shingle panels.
 - e. Shingles.
 - f. Simulated masonry panels.
 - g. Soffit panels.
 - 2. Accessories.
- B. Related Requirements:
 - 1. Section 07 27 26 - Fluid Applied Air Barrier System: Water-resistive barrier under siding.
 - 2. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.
 - 3. Section 09 90 00 - Painting and Coating: Field painting.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022, with Editorial Revision (2023).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.
- C. Test Report: Applicable model code authority evaluation report (e.g. ICC-ES).
- D. Manufacturer's qualification statement.
- E. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
- F. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

- G. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
- C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.
- D. Protect materials from harmful environmental elements, construction dust, and other potentially detrimental conditions.

1.7 FIELD CONDITIONS

- A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.
- C. Manufacturer Warranty: Provide manufacturer warranty for years as indicated under Fiber-Cement Siding article sub-headings for "Warranty". Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Siding:
 - 2. Accessories:
 - a. Northern Facades: www.northernfacades.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 FIBER-CEMENT SIDING

- A. Lap Siding: Individual horizontal boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: Standard lap style.
 - 2. Texture: Smooth.
 - 3. Length: 12 feet (3.7 m), nominal.
 - 4. Width (Height): 5-1/4 inches (133 mm).
 - 5. Thickness: 5/16 inch (8 mm), nominal.
 - 6. Finish: Paint.
 - a. Color: As indicated on Drawings.
 - 7. Warranty: 50 year limited; transferable.
 - 8. Basis of Design Product(s):
- B. Panel Siding: Vertically oriented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Texture: Smooth.
 - 2. Length (Height): 96 inches (2400 mm), nominal.
 - 3. Width: 48 inches (1220 mm).
 - 4. Thickness: 5/16 inch (8 mm), nominal.
 - 5. Finish: Paint.
 - a. Color: As indicated on Drawings.
 - 6. Warranty: 50 year limited; transferable.
 - 7. Basis of Design Product(s):
- C. Plank Siding: Plank boards comprised of cement, mineral fillers, cellulose, and nontoxic fibers, with through-colored construction, complying with ASTM E84, ASTM E136 and NFPA 285, Type A; with both face-fastening and concealed mechanical fastening systems.
 - 1. Texture: Blast.
 - 2. Length (Height): 96 inches (2400 mm), nominal.
 - 3. Width: 48 inches (1220 mm).
 - 4. Finish: Paint.
 - a. Color: As indicated on Drawings.
 - 5. Warranty: 10 years.
 - 6. Basis of Design Product(s):
- D. Shingle Panels: Panels giving appearance of multiple shingles made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: Random width, straight edge.
 - 2. Texture: Smooth.
 - 3. Length: 48 inches (1220 mm).
 - 4. Width (Height): 7 inches (178 mm).
 - 5. Thickness: 1/4 inch (6 mm), nominal.
 - 6. Finish: Paint.
 - a. Color: As indicated on Drawings.
 - 7. Warranty: 50 year limited; transferable.
 - 8. Basis of Design Product(s):
- E. Shingles: Individual simulated wood shingles made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: Straight edged.

2. Texture: Simulated cedar grain.
 3. Length (Height): 18 inches (455 mm), nominal.
 4. Thickness: 1/4 inch (6.4 mm), nominal.
 5. Finish: Paint.
 - a. Color: As indicated on Drawings.
 6. Warranty: 30 year limited; transferable.
 7. Basis of Design Product(s):
- F. Shingles: Individual "wide" shingles made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
1. Style: Straight edged with light wood-grain texture.
 2. Width: Wider than height; manufacturer's standard.
 3. Height: 12 inches (305 mm), nominal.
 4. Thickness: 11/64 inch (4.4 mm).
 5. Finish: Paint.
 - a. Color: As indicated on Drawings.
 6. Warranty: 25 year limited; transferable.
 7. Basis of Design Product(s):
- G. Simulated Masonry Panels: Wall panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with shiplapped machined edges, for concealed clip attachment.
1. Style: Simulated brick appearance.
 2. Height: 18 inches (457 mm).
 3. Width (Length): 72 inches (1828 mm).
 4. Thickness: 3/4 inch (19 mm).
 5. Warranty: 50 year limited; transferable.
 6. Basis of Design Product(s):
- H. Soffit Panels: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
1. Texture: Smooth.
 2. Length: 96 inches (2440 mm), nominal.
 3. Width: 48 inches (1220 mm).
 4. Thickness: 5/16 inch (7.9 mm), nominal.
 5. Finish: Paint.
 - a. Color: As indicated on Drawings.
 6. Manufacturer: Same as siding.

2.4 ACCESSORIES

- A. Support for Cladding and Continuous Insulation: Thermal clips.
1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
 2. Clip Depth: As required for thickness of insulation.
 3. Fasteners: As recommended by clip manufacturer.
 4. Basis of Design Product(s):
 - a. ISO Clip manufactured by Northern Facades.
- B. Furring Strips, Metal: Galvanized metal channels.
- C. Trim: Same material and texture as siding.
- D. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inches (31.8 mm), minimum.

- E. Exterior Soffit Vents: One piece, perforated, ASTM A653/A653M galvanized steel with G90 coating, with edge suitable for direct application to gypsum board and manufactured especially for soffit application, and provide continuous vent.
- F. Sealant: Elastomeric, polyurethane, or silyl-terminated polyether/polyurethane, capable of being painted. Refer to Section 07 92 00 - Joint Sealants.
- G. Finish Paint: Latex house paint acceptable to siding manufacturer; primer recommended by paint manufacturer. Refer to Section 09 90 00 - Painting and Coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that water-resistant barrier has been installed over substrate completely and correctly; refer to Section 07 27 26 - Fluid Applied Air Barrier System.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Protect surrounding areas and adjacent surfaces during execution of this work.
- B. Install Sheet Metal Flashing:

3.3 INSTALLATION

- A. Orientation: Install in orientation indicated on Drawings.
- B. Drainage Mats: Install in accordance with manufacturer's instructions and recommendations.
 - 1. Place mat against exterior wall with fabric side facing out.
 - 2. Mechanically fasten with one fastener per square foot of mat.
 - a. Do not allow fasteners to damage flashing.
 - 3. Seal seams with 2-inch (50.8 mm) wide selvage edge overlap.
 - a. Shingle joints so selvage edge is at bottom.
- C. Install siding in accordance with manufacturer's instructions and recommendations.
 - 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
 - 3. Use trim details as indicated on drawings.
 - 4. Touch up field cut edges before installing.
 - 5. Pre-drill nail holes if necessary to prevent breakage.
- D. Simulated Masonry Panels: Install with manufacturer's recommended clips leaving no fasteners visible.
- E. Over Steel Studs: Use hot-dipped galvanized self-tapping screws, with the points of at least three screws penetrating each stud the panel crosses and at panel ends.
- F. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- G. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- H. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- I. Do not install siding less than 6 inches (152 mm) from ground surface, or closer than 1 inch (25.4 mm) to roofs, patios, porches, and other surfaces where water may collect.

- J. Exterior Soffit Vents: Install in accordance with manufacturer's written instructions and at locations indicated on drawings; provide vent area as indicated on drawings.
- K. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.
- L. Finish Painting: Refer to Section 09 90 00 - Painting and Coating.

3.4 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Clean faced panels in accordance with manufacturer's maintenance instructions, using cleaning materials and methods acceptable to manufacturer.

3.5 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 46 46

SECTION 07 54 19 - FULLY ADHERED TPO MEMBRANE ROOFING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Providing the entire roofing assembly, including, but not limited to:
 - 1. Wood nailers (Refer to this Section and Section 06 10 00)
 - 2. Curbs (Refer to Section 07 72 00)
 - 3. Fully adhered thermoplastic single-ply membrane roofing
 - 4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 63 00)
 - 5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
 - 1. Provide a watertight facility.
 - 2. Conform to all applicable building code requirements and of authorities having jurisdiction.
 - 3. Include Section 07 63 00, and Section 07 72 00, as part of the Work of this Section; and be performed by a single source contractor.
 - 4. Coordinate with General Contractor of temporary equipment and conduit on roof and protection of installed roof membrane.

1.3 RELATED WORK

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
 - 2. D471, Resistance to water absorption
 - 3. D638, Tensile Properties of Plastics
 - 4. D751, Method of Testing Coated Fabrics
 - 5. D1149 Ozone resistance
 - 6. D1204 Linear Dimensional Change
 - 7. D 2137 Brittleness point, max,
 - 8. D 4637/6878(annex A1) Thickness over scrim
 - 9. E 96 Water vapor permeance, Perms
 - 10. E 903 Solar Reflectance (albedo X 100), %
 - 11. G 151/154 Accelerated weathering
 - 12. FTM 101C method 2031 Puncture resistance
- B. ASCE-7-22 Wind uplifts requirements for geographical area.

- C. Federal Specifications (FS)
 - 1. TT-S-00230C
- D. National Roofing Contractors Association (NRCA)
 - 1. Roofing and Waterproofing Manual (Latest Edition)
- E. Single Ply Roofing Institute (SPRI)
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual (Latest Edition)
- G. Underwriters' Laboratories (UL)
 - 1. Fire Hazard Classifications
- H. International Building Code
- I. Texas Windstorm Certificate
 - 1. Texas Board of Insurance Windstorm Regulations
- J. ANSI / SPRI ES-1

1.5 PERFORMANCE REQUIREMENTS

- A. General Requirements: Provide an installed thermoplastic single ply roofing system, as manufactured by Carlisle Roofing Systems, Inc., flashing and related work that is watertight and will not permit the passage of liquid water, able to withstand wind loads, thermally induced movement and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Roofing System Design: Comply with ANSI/SPRI "Wind Design Standard Practice for Roofing Assemblies" for the following ground roughness exposure and system design:
 - 1. Fully Adhered thermoplastic single-ply membrane roofing.
- D. Underwriter's Laboratories Inc. (UL)
 - 1. UL RMSD – Current Roofing Materials and Systems Directory
 - 2. UL Fire Resistance of Roofing Coverings Materials
 - 3. Exterior Fire Exposure Classification: Class A, ASTM E 108, for application and slopes shown.
- E. American Architectural Manufacturer's Association (AAMA)
- F. Occupational Safety and Health Administration (OSHA)
- G. International Building Code (IBC)

1.6 SUBMITTALS

- A. Product Data: Manufacturer's printed instructions, tested assemblies, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, adhesive, and accessories to be used in the Work.

- B. Certifications:
 - 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system.
 - 2. Manufacturer's affidavits that materials used in Project contain no asbestos.
 - 3. Manufacturer's written certification of approval / acceptance of these specifications and details.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Shop Drawings: Furnish from copies of the Manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", (Latest Edition).
 - 1. Furnish for approval any proposed details, which differ from those, included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
 - 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.
- E. Samples:
 - 1. Furnish copy of sample warranty that is to be issued upon project completion.
- F. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
 - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 - 2. Contractor's Warranty: Contractor's written warranty as specified.
 - 3. Maintenance Procedures: Three (3) copies of Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
 - 4. Affidavits of non-asbestos for material.
 - 5. Refer to Section 01 78 39 for additional requirements of close-out documents.

1.7 INSPECTIONS / TESTS

- A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
 - 1 Architect Observations: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
 - 2 Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material manufacturer **monthly** during performance of Work to ensure that said project is installed in accordance with the Manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
 - b. The authorized material Manufacturer's field representative shall be responsible for:
 - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
 - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.

- 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.
- B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
 1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
 3. **Non compliance with contractor requirements will result in the Architect / Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.**

1.8 QUALITY ASSURANCE

- A. **Installer:**
 1. **The existing installed roofing system is currently still under warranty. The existing system is covered under a Golden Seal Total Roofing Warranty (Warranty No. 10169579) from Carlisle Roofing Systems, Inc.**
 2. **All alterations to the existing Roofing System must be completed by a Carlisle Authorized Applicator. The Carlisle Authorized Applicator must notify Carlisle when the revision work is complete. The necessary form can be found on the Carlisle website via the Authorized Applicators login.**
- B. **Regulatory Requirements:**
 1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
 2. Roofing system shall be installed in accordance with ASCE-7-22 wind uplift requirements for geographical location exposure B, 114 MPH 3-second gust wind speed zone and risk category III based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
 - a. Zone 1' Field 18.9 psf or as otherwise indicated by Structural
 - b. Zone 1 Field 33 psf or as otherwise indicated by Structural
 - c. Zone 2 Perimeter 43.5 psf or as otherwise indicated by Structural
 - d. Zone 3 Corner 43.5 psf or as otherwise indicated by Structural
 3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.
- C. **Texas State Board of Insurance Windstorm Regulations:** Owner will provide inspector to meet all requirements. Installers to coordinate all applicable roof inspections with Owners Inspector.
- D. **Laboratory Testing and Samples:**
 1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.

2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Installer shall assume all costs for extraction and patch of all samples.
 3. Re-tests for work which fail initial tests or installer shall pay inspections.
 4. Installer shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.
- E. Installation:
1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
 2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Installer's Association.
 3. It will be the installer's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the installer shall be responsible for the correctness of it. Any drawings supplied are for reference only.
 4. Installer shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
 5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
 6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all installers' equipment and materials removed from the site.

1.9 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in Manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels, shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- B. Manufacturer's packaging and / or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All materials stored, as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40° F in heated storage.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.

- E. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.11 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
 - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
 - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 - 3. The roof system including roofing insulation, flashing, penetrations, wall flashings, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
 - 4. Submit four (4) original executed copies of the Warranty / Guarantee.
- B. Roofing Installer: Jointly with any sub installers employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Installer, and sub installers, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.
- D. Submit attached Installer's Warranty and Sub installer's Guarantee forms at Project Closeout.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The components of the roof system are intended to be products of a single manufacturer, Carlisle Roofing Systems, Inc., as required providing the specified system warranty. Products not manufactured by the membrane manufacture, but are required in the roofing assembly, will be recognized by the roofing manufacture and covered under the manufacturer's warranty.
- B. Install all materials in accordance with manufacturer's current written specifications and details. Deviations shall not be made without prior written approval from the manufacturer and the Owner's Representative. Should any specifications or details conflict with the Contract Documents, submit to Owner the recommended alternative that provides the best long term moisture protection and complies with manufacturer's warranty requirements for approval.

2.2 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.3 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Roof Related Sheet Metal.

2.4 APPROVED MANUFACTURERS

- A. Specifications are based on "Sure-Weld TPO", fully adhered TPO single-ply roofing system manufactured by **Carlisle Roofing Systems Inc..**
- B. **All alterations to the existing Roofing System must be completed by a Carlisle Authorized Applicator. The Carlisle Authorized Applicator must notify Carlisle when the revision work is complete. The necessary form can be found on the Carlisle website via the Authorized Applicators login.**
- C. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.
- D. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
- E. All materials used on the project shall be asbestos free.

2.5 ROOF MEMBRANE ASSEMBLY

- A. TPO Sheet: Uniform, flexible sheet formed from thermoplastic polyolefin, of the following type, thickness, and exposed face color:
 - 1. Polyester-reinforced TPO.
 - 2. TPO Polymer Thickness: 60 mils
 - 3. ASCE-7-22 Wind uplift requirements
 - 4. UL Class A.
 - 5. Exposed Face Color: White

2.6 ROOF INSULATION

- A. **All alterations to the existing roofing system insulation installations are to match like and kind materials and thicknesses.** All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, with UL and FM approval.
- B. Cover Board: Glass-Faced Gypsum Roof Board equal to UL rated Type X "DensDeck Prime Roof Board w/ Eonic Technology" as manufactured by Georgia-Pacific. Stock board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. Provide as required by manufacturer recommendation for project roof system(s). Approved substitute, SECUROCK by USG.
- C. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20 psi minimum compressive strength. Thickness shall be a minimum total of 4.4" (or size specified on drawings) and divided in two staggered layers. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.

- D. Polyisocyanurate Tapered Roof Insulation: (As Required) Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20 psi minimum compressive strength. Provide factory cut 48" x 48" stock board. Slope and thickness to vary as required to achieve a minimum 1/4" per foot finished slope unless noted otherwise on the Drawings (cricketed areas between roof drains / scuppers are to achieve a minimum 1/2" per foot slope). Provide 1/2" cover board similar to that specified above tapered polyisocyanurate board insulation. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.
- E. Tapered "Fesco" Edge Strip: 0" to 1 1/2" tapered (or as required for field conditions), 18" wide x 48" long. Install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Basis of specification shall be as manufactured by Johns Manville or approved substitute.

2.7 ACCESSORIES

- A. General: Furnish auxiliary materials recommended by Roofing System Manufacturer for intended use and compatible with membrane roofing materials.
1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdictions.
- B. Protective Film: Tough protective film to help prevent scuffs and scratches on membrane during the construction process. Removable 5' sections that can stay in place for months, resisting the effects of, heat, UV exposure, rain, and wind. Once the film is removed, no residue remains on the thermoplastic sheet.
- C. Flashing and Flashing Accessories: As recommended by the Thermoplastic sheet Manufacturer's printed instructions for reinforced sheet flashing of same material, type, thickness, and color as sheet membrane.
- D. Fasteners: FM Approved corrosion resistant steel screws of the appropriate size for fasteners for roof membrane and insulation attachment and for sheet metal flashing. Fasteners for the membrane shall be supplied by the Thermoplastic Manufacturer and are to be installed as recommended by Thermoplastic Sheet Manufacturer's printed instructions.
- 1 Shall be Factory Mutual approved and supplied by the Manufacturer for the specific application.
 - 2 Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
 - 3 Fastener for Wood and Metal Deck: Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal.
 - 4 Nails: G-90 galvanized or non-ferrous type, size as required to suit application, minimum 11 gauge with 3/8 inch diameter head.
 - 5 Dual Prong Fastener: Coated Steel tube with stainless steel Locking Staple.
- E. Bonding Adhesive: As recommended by Thermoplastic Sheet Manufacturer's printed instructions to develop a bond between the membrane and the substrate to which the membrane is to be attached.
- F. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1-inch (25-mm) wide, roll formed and pre-punched.

- G. Metal Flashings, Copings, Edge Trim and Accessories: Provide all roofing Manufacturer's metal required for a complete roofing system covered under the Manufacturer's warranty.
- H. Sealants: Membrane Manufacturer's approved sealant shall be used to seal penetrations through the membrane system and at miscellaneous sealant applications that come in contact with roof systems components.
- I. Walkpads / Protection Pads: Provide a polyester reinforced, weldable membrane with embossment similar to a chevron pattern.
 - 1. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
 - 2. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
 - 3. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.
- J. Miscellaneous Accessories: Provide pourable sealants, performed cone and vent sheet flashings, pre-formed inside and outside corner sheet flashings, T-joint covers, termination reglets and other accessories as recommended by Roof System Manufacturer for intended use.
- K. Other miscellaneous materials shall be of the best grade available and approved in writing by Roof System Manufacturer, prior to use, for the specific application.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Existing Conditions: Examine existing building and new construction to determine existing physical conditions that affect installation of new roofing.
- B. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to Manufacturer's written instructions and warranty requirements.
- C. Environmental Requirements:
 - 1. Apply roofing in dry weather.
 - 2. Do not expose roof components and flashing in inclement weather or when it is predicted 30% or more possibility for inclement weather.
 - 3. When ambient temperature is below 40 degrees Fahrenheit, expose only enough sensitive cements, sealants, and adhesives as required for use within a four-hour period.
 - 4. Do not expose membrane and accessories to a constant temperature of 180 degrees Fahrenheit.
- D. Protection:
 - 1. Provide special protection and avoid traffic on completed areas of membrane installation.
 - 2. Restore to original condition or replace work or materials damaged during handling of roof materials.
 - 3. Take precautions as required to protect adjacent work and structures.
- E. Emergency Equipment: Maintain on site equipment necessary to apply emergency temporary edge seal in event of sudden storms or inclement weather.

- F. Restrictions:
1. Comply with General Requirements on use of site.
 2. Smoking is prohibited on all roof areas or in existing buildings.
 3. Maintain facility and all utility services in a functional condition.
 4. Provide sanitary facilities for employees.

3.2 EXAMINATION

- A. Examine and verify that receiving substrate surfaces of the structure have no defects or errors, which would result in poor or potentially defective application or cause latent defects in workmanship.
1. Examine substrate to which roofing material is to be applied to ensure that its condition is satisfactory for roofing application. Do not permit voids greater than 1/4 inch wide in the substrate. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of thermoplastic sheets.
- B. Verify that roofing openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected. Starting installation shall imply acceptance of surfaces and conditions.

3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
- B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed or to existing raised roof edge whichever is applicable. Nailers shall be anchored to resist a pullout force of 300 pounds per linear foot per Factory Mutual Data Sheet 1-49. Fasteners shall be no less than two (2) per nailer, and be spaced at two (2) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of eight (8) inches above the deck.

3.4 SUBSTRATE PREPARATION

- A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or Manufacturer's requirements.
- B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.
- C. The membrane manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.
- D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. Remove sharp projections.
- E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

- F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.5 APPLICATION OF INSULATION

- A. General: (As required per roof area)
 - 1. Manufacturer's Instructions: In regard to attachment, the Manufacturer's instructions or specifications shall determine the suitability for an application.
 - 2. Fastener pull out test will be required for verification of condition of the metal decking and suitability of Manufacturer's metal fasteners
 - 3. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners. The surface of the insulation or substrate shall be inspected prior to installation of the thermoplastic roof membrane. The substrate shall be clean, dry and smooth with no excessive surface roughness, contaminated surfaces or unsound surfaces such as broken, delaminated, or damaged insulation boards. Any wet, broken, delaminated, or damaged insulation shall be replaced with new insulation.
 - 4. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered minimum 24" vertically and horizontally and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
 - 5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
 - 6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and / or as required NRCA standards.
- B. Specified polyisocyanurate insulation shall be mechanically attached to metal deck meeting Factory Mutual recommendations for wind uplift as dictated by wind zone applicable to location of project. Subsequent layer of recovery board shall be full adhered to underlying polyisocyanurate insulation in low rise foam meeting Factory Mutual recommendations for wind uplift as dictated by wind zone applicable to location of project. Adhesive and thickness shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of Factory Mutual and the Manufacturer that are in effect at the time of this project.
- C. Insulation shall be laid bearing on deck surface / flats. The long dimension of base insulation layer must be fully supported by the top flange of the metal deck. The edges of insulation boards must not cantilever over the flutes of the metal deck.

3.6 INSTALLATION OF FLEECEBACK TPO MEMBRANE

- A. General: Install in strict accordance with manufacturer's latest published requirements, instructions, specifications, and details and approved shop drawings.
- B. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.
- C. Lay out the membrane pieces so that field and flashing splices are installed to shed water.

- D. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
- E. Install membrane adhered to the substrate, with edge securement as specified.
- F. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.
 - 1. Do not apply bonding material to seaming area of membrane.
- G. Roll the installed membrane with a weighted roller to ensure full contact with the substrate.
- H. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches (1:6) using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
 - 1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches square.
 - 2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.
- I. Weld cover strips at all seams that do not have a factory selvage edge.

3.7 SEAM INSTALLATION

- A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to Manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:
 - 1. Weld Method: Hot Air
- B. Test lap edges with probe to verify seam weld continuity on a daily basis. Perform pull-tests of welded lap seam samples daily and install T-joint patches at all t-joint intersections of membrane and flashing seams.
- C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.8 FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system Manufacturer's written instructions.
- B. $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
- C. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- D. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by Manufacturer.
- E. Clean seam areas, overlap seams, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- F. Test lap edges with probe to verify seam weld continuity. Apply lap sealant, if required by roofing manufacturer, and seal exposed edges of sheet flashing terminations per Manufacturer's requirements.

- G. Terminate and seal top sheet flashings and mechanically anchor to substrate through termination bars.

3.9 METAL FLASHINGS, COPINGS, EDGE TRIM AND ACCESSORIES INSTALLATION

- A. General: Secure metal flashings accessories at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

3.10 QUALITY CONTROL

- A. Roofing Installer: On-site evaluation welded seams shall be made by the Contractor to locations as directed by the Owner's representative or TPO Manufacturer's technical representative. Two-inch wide cross-section samples shall be taken three times a day minimum through completed seams. Correct welds shall display failure from shearing of the membrane prior to separation of weld. The Contractor at no extra charge to the Owner shall patch each test cut. Test seam samples shall be label with location of seam cut, date of seam cut, and retain for Owner's representative or TPO Manufacturer's technical representative for test cut inspection.
- B. Manufacturer's Quality Control Inspection: The Manufacturer's Technical Representative shall review the on-going work on a minimum of one time every 30 calendar days. All defects noted non-compliance with the Contract Documents, or the recommendations of the Thermoplastic Manufacturer should be itemized in a punch list. These items must be corrected immediately by the Contractor to the satisfaction of the Owner's Representative and the thermoplastic manufacturer.

3.11 PROTECTING AND CLEANING

- A. Protect sheet membrane roofing from damage and wear during remainder of construction period.
- B. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the Work of this Section and / or upon adjacent areas or surfaces, which result from the Work of this Section.
- C. Upon completion of the Work of this Section, dispose of, away from the Site, all debris, trash, containers, residue, roofing remnants and scraps which results from the Work of this Section.
- D. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.
- E. Overnight Seal / Water Cut-Off:
 - 1. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
 - 2. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.
- F. Upon completion of all roof related construction (including MEP), peel protective film from thermoplastic membrane to not damage the membrane. Clean areas of sheet not covered by film to match.

3.12 ACCEPTANCE

- A. Prior to demobilization from the site, the Owner / Project Manager, Architect and Installer shall review the work. All defects noted noncompliance with the Contract Document or the recommendations of the TPO Manufacturer should be itemized in a punch list. These items must be corrected immediately by the Contractor prior to demobilization to the satisfaction of the Owner / Project Manager, and the TPO Manufacturer.
- B. Notify Architect and Owner 48 hours in advance of the date and time of inspection.
- C. All warranties as required for the project of this specification shall be submitted for approval prior to final payment.

END OF SECTION

SECTION 07 62 00 - ROOF RELATED SHEET METAL

PART I – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. It is the intent of this Section that the Work shall:
 - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 2. include all shop and field formed sheet metal work shown on drawings, specified, or required, including, but not limited to:
 - a. Roof penetration sleeves and hood and umbrella counterflashing
 - b. Metal counterflashing
 - c. Expansion joint
 - d. Roof drains
 - e. Scuppers
 - f. Metal perimeter edge
 - g. Gutters, Downspouts, Splash Blocks and Splash Pans
 - h. One-way roof moisture relief vents
 - i. Metal gravity vents
 - j. Metal heat exhaust vents
 - k. Sanitary vent pipes
 - l. Pipe box
 - m. Copings, trim and miscellaneous sheet metal accessories.
 - 3. be part of the Work of the Roofing System; and
 - 4. be performed by a single source contractor.

1.3 RELATED WORK

- A. Section 07 52 19 - Modified Bitumen Membrane Roofing System
- B. Section 07 52 19 - Modified Bitumen "Cool Roof" Membrane Roofing System
- C. Section 07 54 23 – Mechanically Attached Thermoplastic Single Ply Membrane Roofing System
- D. Section 07 54 19 – Fully Adhered Thermoplastic Membrane Roofing System
- E. Section 07 72 00 – Roof Accessories
- F. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing, and electrical items.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

- 3. B32, Standard Specification for Solder Metal
- 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. ASCE 7
- C. Federal Specifications (FS)
 - 1. QQ-L-201 for lead
- D. National Association of Architectural Metal Manufacturers (NAAMM)
- E. National Roofing Contractors Association (NRCA)
 - 1. Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual
- G. ANSI / SPRI ES-1
- H. ANSI / SPRI GT-1

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
 - 1) Full range of finish colors for Architect's selection.
 - 2) 12-inch-long sample of each specified item with approved finish.
 - 3) Provide full size mockup of all shop-built assemblies.
 - 4) Documentation of Wind uplift requirements for Roof Edge for specific project location
 - a. Wind Calculator available online

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 160 MPH wind speed zone and wind resistance loads.
- D. ANSI / SPRI GT-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI GT-1 / FM 1-49 for minimum of up to 160 MPH wind speed zone and wind resistance loads.

1.7 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13, Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.9 WARRANTIES

- A. Manufacturer's Product Warranty:
- 1) Manufacturer's standard 30-year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2) Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3) Wind Warranty
 - a. Non-Coastal: up to 160 MPH Blow Off Resistance, 20 Year
 - 4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
 - 5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.
- B. Roofing Contractor's Warranty:
1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
 2. Defects shall include, but not be limited to:
 - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
 - b. Leaking water or bitumen within building or construction.
 - c. Becoming loose from substrate / blocking.
 - d. Loose or missing parts.
 - e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Berridge Manufacturing Co., which is located at: 2610 Harry Wurzbach Road.; San Antonio, TX 78209; Toll Free Tel: 800-669-0009; Tel: 210-898-4896; Fax: 210-650-0379; Web: www.berridge.com
- B. Substitutions: Before proposal date upon roof consultant approval.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012513.

- D. Manufacturers named within specification are approved for use on the Project providing:
1. their products meet or exceed the specifications;
 2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
 3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
 4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Galvanized Sheet Steel:
1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of] colors.
- C. Prefinished Galvalume Sheet Steel:
1. Commercial quality ASTM A792/792M
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of] colors.
- D. Membrane Clad Sheet Steel:
1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: TPO coating as per Membrane Manufacturer's requirements.
- E. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2-inch diameter head.
 2. Washers: Steel washers with bonded rubber sealing gasket.
 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.

- E. Clips:
 - 1. Cleat (coping / fascia): Minimum 22-gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
 - 1. Phosphoric acid type, manufacturer's standard.
 - a. For Use with Steel or Copper: Rosin flux
 - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
 - 1. At expansion joints: to be used as bellow; 23 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Sika.
 - 2. At wood blockings: High-Temp Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps, and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
 - 1. Type A:
 - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
 - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
 - 2. Type B:
 - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e., metal edge, cover plates, etc.
 - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Grout - Pitch Pans:
 - 1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
 - 2. Approved Products / Manufacturers: "Sure Grip High Performance Grout" manufactured by Dayton Superior Corporation, "Premier Quick-Trim"

manufactured by L & M Construction Chemicals, Inc., "MasterFlow" manufactured by BASF, or approved equal.

- H. Pitch Pan Filler:
 - 1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
 - 2. Approved Products / Manufacturers: "Quick Pitch Sealer" manufactured by U.S. Intec, "SPM Pourable Sealer" manufactured by Johns Manville, or approved equal.
- I. Termination Bar:
 - 1. Material: Stainless steel or extruded aluminum bar with lipped profile.
 - 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4-inch x 3/8-inch oval holes spaced six (6) inches on center.
 - 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp. or approved equal.
- J. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.
- K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- L. Splash Pans: 22-gauge stainless steel of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers, and counterflashing's in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Comply with manufacturer's installation instructions and recommendations.
- C. Shop fabricate Thru-wall, counterflashing's, expansion joint metal and wind clips to greatest extent possible.
- D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.
- E. Face of any fabricated vertical metal fascia or coping shall not exceed 8" without stiffener band or bird's beak. If stiffener band or bird's beak cannot be fabricated, contractor to use multiple pieces of metal to achieve overall distance without going over the 8" maximum per piece.
- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage, or deterioration of the work.
- G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.

- I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.
- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
 - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
 - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
 - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.
- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Back paint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

- A. Metal Flashings:
 - 1. Through Wall Receiver Tray: Minimum 24-gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than $\frac{3}{4}$ ".
 - 2. Counterflashing's: Minimum [24-gauge stainless steel] formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24-gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.
- C. Roof Penetrations:
 - 1. Umbrella Counterflashing: Two-piece construction of minimum 22-gauge stainless steel, fabricated in accordance with drawings or project requirements.
 - 2. Flashing Pans:
 - a. 24-gauge stainless steel.
 - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
 - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4-inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
 - d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4-inch steel plate. Draw band bonnets fabricated from 22-gauge stainless steel may be used on circular projections.

D. Metal Edge / Fascia:

I. Perma-Tite System 200 Fascia for thermoplastic roof systems: Decorative metal fascia with continuous formed rail or shop fabricated per National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual and ANSI / SPRI ES-1.

- 1) Construction:
 - a) Fascia metal gauge
 - 1) 24-gauge galvanized steel.
 - b) Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of colors.
 - c) Formed Rail: Shall be continuous 20-gauge galvanized steel at 12'-0" standard lengths with pre-punched slotted holes and 6" stainless steel springs at 4'-0" on center.
- 2) Thermoplastic Version
 - a) Model:
 - 1) FA-80 (8.25" Face)
 - b) Performance:
 - 1) 20-year, 180 mph Wind Warranty.
 - 2) Tested per ANSI / SPRI ES-1 / FM 4435 Standard to a design pressure of 200 psf to comply with the International Building Code.
 - 3) FM tested to a minimum FM 1-180 rating

E. Metal Coping

1. Perma-Tite Coping or shop fabricated per National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual and ANSI / SPRI ES-1.

- 1) Construction:
 - a) Metal:
 - 1) 24-gauge galvanized steel.
 - b) Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of colors.
- 2) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
- 3) Coping Vertical Face and Back Leg: 2 1/4" to 12 1/2" manufactured to job requirements.
- 4) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
- 5) Anchor / Support Cleat: 20-gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
- 6) Fasteners: 1 1/2" stainless steel with driver.
- 7) Performance:
 - a) 20 Year, 160 mph Wind Warranty
 - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
 - c) Factory Mutual 1-90 approved for wind up lift protection.
 - d) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".

- F. Continuous Cleats (where applicable): Continuous strips, same material, and profile, minimum one gauge heavier of item which cleats attach.
- G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel, or as shown or directed otherwise.
- H. Angle Termination Bar: Aluminum pressure bar 1/8-inch x one (1) inch.
- I. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- J. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer or shop fabricated per National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual and ANSI / SPRI GT-1.
 - 1. Minimum [24-gauge prefinished galvanized steel], formed in maximum twelve (12) foot lengths.
 - 2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 - 3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c., 1/8" Stainless Steel Pop Rivets, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
 - 4. 24-gauge galvanized steel with membrane manufacturer's coating (specify)
 - 5. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing PVC).
 - 6. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets, and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
 - 7. Install all anchoring devices as outlined in manufacturer literature.
 - 8. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
 - 9. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100-inch-thick downspout straps: Strap type, like metal, match color.
 - 10. Downspouts: Minimum [24-gauge prefinished galvanized steel] (match color).
 - 11. Downspout straps: Strap type, like metal, match color.
 - 12. Gutter Screen: .050" Aluminum with 1/4" dia. perforations
 - 13. Collect Heads: Minimum [24-gauge prefinished galvanized steel] (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

- A. Field measure site conditions prior to fabrication work.

- B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4-inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
1. Prefabricated corners;
 2. transitions;
 3. changes in direction, elevation, and plane; and
 4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
1. Ensure approved fasteners are used throughout the project.
 2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips, and cleats.
 3. Ensure sufficient amount of water block is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning-stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
 2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
 3. Coordinate installation of through-wall flashing with the masonry contractor.
 4. Seal through-wall in conjunction with masonry wall waterproofing.
 5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- G. Pitch Pans, Metal Flanges (As Required):
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
 2. Prime all metal flanges with asphalt primer prior to flashing installation.

3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
 4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
 5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
 6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.
- H. Sanitary Vent Stacks Modified Bitumen
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
 2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.
- I. Sanitary Vent Stacks: Thermoplastic Roof System
1. Prepare substrate and fit pre-molded pipe boot.
 2. Heat weld pipe boot flange to prepared thermoplastic field membrane.
 3. Apply sealant as recommended by membrane manufacturer to inside of the top edge of the pipe boot. Install stainless steel pipe clamp ensuring no wrinkles or folds in the pipe boot membrane. Apply second bead of sealant at the top of the pipe boot.
 4. Install sheet metal umbrella flashing, pipe clamp and sealant above top of pipe boot.
- J. Gutters / Downspouts:
1. Install gutters prior to edge metal and otherwise as detailed.
 2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer).
 3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.
- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

BEAM Professionals
PBK Project No. 25003301
Issue for Bid

Northeast Lakeview College, Sundance Renovation
Alamo Colleges District - Northeast Lakeview College
September 24, 2025

END OF SECTION 07 62 00

ROOF RELATED SHEET METAL
07 62 00 - 12

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pre-finished galvanized steel gutters and downspouts.
 - 2. Precast concrete splash pads.
 - 3. Sheet metal splash pans.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Metal downspout boots and downspout guards.
 - 2. Section 07 62 00 - Roof Related Sheet Metal.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Maintain one copy of each document on site.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- D. Samples: Submit two samples, 6 inch (150 mm) long illustrating component design, finish, color, and configuration.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials that could cause discoloration, staining, or damage.

1.7 WARRANTY

- A. Manufacturer's Product Warranty:
 - 1. Manufacturer's standard 30-year finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2. Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3. Correction may include repair or replacement of failed product as outlined in Warranty Documents
 - 4. Finish warranty and wind warranty shall be delivered by the Contractor to the Owner at the conclusion of project as part of project closeout documents.
- B. Contractor's Warranty:
 - 1. The Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the gutters, downspouts, and conductor heads will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include, but not be limited to:
 - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
 - b. Leaking water or bitumen within building or construction.
 - c. Becoming loose from substrate / blocking.
 - d. Loose or missing parts.
 - e. Finish failure as defined above.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Gutters and Downspouts:
 - a. Alside, Inc: www.alside.com.
 - b. ATAS International, Inc.: www.atas.com.
 - c. Cheney Flashing Company: www.cheneyflashing.com/.
 - d. Drexel Metals Inc: www.drexmet.com.
 - e. Hickman Edge Systems: www.hickmanedgesystems.com.
 - f. Metal-Era, an MTL Company: www.metalera.com.
 - 2. Scupper and Collectors:
 - a. ATAS International, Inc.: www.atas.com.
 - b. Metal-Era, an MTL Company: www.metalera.com.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
 - 1. Finish: Shop pre-coated with modified silicone coating.
 - 2. Color: As indicated on Drawings.

2.4 COMPONENTS

- A. Basis of Design Product:
 - 1. Seal-Tite Industrial Gutter IG-B manufactured by Metal-Era.
- B. General Requirements:
 - 1. Minimum 24-gauge prefinished galvanized steel, formed in maximum 12 foot lengths.
 - 2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 - 3. Install all anchoring devices as outlined in manufacturer literature.
- C. Gutters:
 - 1. Profile as indicated on Drawings.
 - 2. Form in maximum lengths of 12 feet.
 - 3. Supply Drip Edge at gutter.
 - 4. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
 - 5. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
 - 6. Gutter Straps and Supports: Minimum 3 per 12 foot length, 0.100 inch thick downspout straps: Strap type, like metal, match color.
 - 7. Gutter Screen: 0.050 inch Aluminum with 1/4 inch dia. perforations.
- D. Downspouts:
 - 1. Profile as indicated on Drawings.
 - 2. Downspouts: Minimum 24-gauge prefinished galvanized steel (match color).
- E. Scuppers and Collectors:
 - 1. Profile as indicated on Drawings.
 - 2. Collector Heads: Minimum 24-gauge prefinished galvanized steel (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.
- F. Anchors and Supports:
 - 1. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets, and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
 - 2. Anchoring Devices: As recommended by fabricator.
 - 3. Gutter Supports: 2 inch Wide Gutter Straps at 24 inches o.c., Wind Straps 6 feet o.c., 1/8 inch Stainless Steel Pop Rivets, and #10 by 2 inch Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer..
 - 4. Downspout Supports: Strap type, like metal, match color.
- G. Accessories:

2.5 FABRICATION

- A. Form gutters and downspouts of profiles and size(s) indicated on Drawings.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.6 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.3 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters ____ inch per foot (____ mm/m) .
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

END OF SECTION 07 71 23

SECTION 07 22 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 INSTALLATION RESPONSIBILITY

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
 - 1. Roofing
 - 2. Roofing sheet metal
 - 3. Mechanical equipment
 - 4. Plumbing
 - 5. Electrical

1.3 REFERENCES

- A. Federal Specifications (FS)
 - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish
 - 2. Water infiltration into the building or within the construction.

- C. Rooftop supports – 5 year limited warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

- A. Frames:
1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
 - a. Minimum 18 gauge, and as engineered by manufacturer.
 - b. Minimum 18 gauge for curbs supporting HVAC units
 - c. Minimum 20 gauge for expansion joint curbs.
 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
 3. Base Plates: Integral to frame and welded.
 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
 5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- E. Counterflashing: 24 gauge stainless steel
- F. Counterflashing Cap: Stainless steel.
- G. Cants:
1. Non-canted curb style installs either under or on top of metal decks with insulation.
- H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- I. Approved Manufacturers:
1. Custom Curb, Inc.
 2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Contractor built supports are not allowed)

- A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3" O.D. and smaller.
 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3" O.D.
 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel channel, rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3" O.D. and smaller.
 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3" O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- D. Crossover / Steps Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless steel channel, rods, washers and nuts; Basis of design, PHP Crossover.
 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- E. Installation:
1. Provide pipe supports at no greater than 8'-0" o.c. or as otherwise indicated in Manufacturer's Shop Drawings.
 2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6'-0" o.c.
 3. Provide complete and adequate support of all piping, ducts and conduit.
 4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
 5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

2.4 PIPE EXTENSIONS

- A. Prefabricated plumbing vent pipe extensions.
- B. As manufactured by Tubos Inc., (727) 504-0633, info@tubos.biz, or visit the Tubos web site www.Tubos.biz. or Architect approved equal.

2.5 ROOF PENETRATION HOUSING

- A. Provide rain-proof our-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and water tight. To be used with our exclusive two-piece aluminum and / or stainless steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.
- B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.
- D. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

1.4 ALLOWANCES

- A. Penetration firestopping Work is part of an allowance.

1.5 UNIT PRICES

- A. Work of this Section is affected by unit prices.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.8 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to GlobalFM 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.11 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

1.12 WARRANTY

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace firestopping materials that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.4 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01 in. wg (2.49 Pa).
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01 in. wg (2.49 Pa).
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50 cfm (0.024 cu. m/s) 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.5 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.6 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375 inch (9.5 mm) strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

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SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2024.
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus; 2025.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.
- E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section.
 - 1. Meeting to include the Owner's Designated Representative (ODR), the Architect, the Contractor, fabricator's representative, installer, and representatives of related trades.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 'sFM 4991, "Standard for the Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.4 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.
 - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Control and expansion joints on exposed surfaces.
 - 2. Perimeter joints between wall surfaces and frames of doors and openings.
 - 3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 4. Joints indicated or as necessary.
 - 5. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2024.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- E. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- L. ASTM E2129 - Standard Practice for Data Collection for Sustainability Assessment of Building Products; Current.

1.4 SUBMITTALS

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
 - 1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
 - a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.

- b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
 - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.
 2. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
 3. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- B. Certificates and Reports:
 1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
 2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
 3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
 - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
 6. Field Adhesion Test Reports: For each sealant application tested.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
 1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
 2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
 1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
 - a. VOC Content of Interior Sealants: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions for VOC limits of sealants installed within the building.
 - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
 - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

- A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion, 20 years for silicone sealants.
- C. Warranties specified exclude deterioration or failure of sealants from:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:

1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates, air barrier system, and masonry under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.
- B. Liquid Applied Sealants: Comply with ASTM C920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide non-staining products that have undergone testing according to ASTM C1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacturer's full line of standard colors.
- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and non-sag compounds elsewhere except as shown or specified.
- H. Silicone Sealant: ASTM C920 Type S, Grade NS, Class 50.
 1. Basis of Design Product:
 - a. Dowsil 795 Silicone Building Sealant manufactured by The Dow Chemical Company.
 2. Properties: One-part, neutral-cure, non-sag silicone sealant; FS TT-S-00230C, Type II, Class A; SWRI validated..
 3. Movement: Plus or minus 50 percent capability at vertical joints.
- I. Silicone Sealant: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 1. Basis of Design Product:
 - a. 756 Silicone Building Sealant - HP with Additive manufactured by Dow Corning.
 2. Use: Precast Concrete Joints between metals, glass, and plastics (Two part silicone sealants).
 3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
 4. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
- J. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 50, use NT.
 1. Basis of Design Products:
 - a. Omniseal 50 manufactured by BASF Building Systems.
 - b. 756 SMS, 791, 795, and/or 995 (as applicable) manufactured by Dow Corning Corporation.

- c. Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 (as applicable) manufactured by GE Advanced Materials.
 - d. SikaSil-C995 manufactured by Sika Corporation, Construction Products Division.
 - 2. Use: Precast Concrete Joints between metals, glass, and plastics (Single component sealants).
 - 3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates.
 - 4. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
- K. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Basis of Design Products:
 - a. Sonolastic NP-2 manufactured by BASF Building Systems.
 - b. Dynatred manufactured by Pecora Corporation.
 - c. Sikaflex 2c NS or Sikaflex 2c NS TG (as applicable) manufactured by Sika Corporation, Construction Products Division.
 - 2. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
 - 3. Properties: Performance: Non-staining, non-bleeding, non-streaking to sealed and adjacent substrates.
- L. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
 - 1. Basis of Design Products:
 - a. NP 2 manufactured by BASD Construction Chemicals.
 - b. Permathane SM 7200 manufactured by Schnee-Morehead, Inc.
 - c. Sikaflex - 2c NS TG manufactured by Sika Corporation, Inc.
 - 2. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
 - 3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
- M. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
 - 1. Basis of Design Products:
 - a. Omniplus manufactured by BASF Building Systems.
 - b. 786 Mildew Resistant Silicone Sealant manufactured by Dow Corning.
 - c. Sanitary SCS 1700 manufactured by GE Silicones.
 - 2. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.
- N. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C834, Type OP (opaque sealants):
 - 1. Basis of Design Products:
 - a. Sonolastic Sonolac manufactured by BASF Building Systems.
 - b. AC-20 + Silicone manufactured by Pecora Corporation.
- O. Acoustical Joint Sealant: Non-sag, paintable, non-staining, latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Basis of Design Products:
 - a. Tremco Acoustical Sealant manufactured by Tremco.

- P. Sealant Backing: Provide sealant backings that are non-staining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Basis of Design Products:
 2. Cylindrical Sealant Backings: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding backings of flexible plastic foam complying with ASTM C1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
 3. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:
- Q. Butyl Mastic Tape: High-tack, self-fusing butyl rubber mastic.
1. Basis of Design Product:
 - a. Butyl Mastic Tape 2212 manufactured by 3M.
 2. Compatible with air barrier system.
 3. Locations: At masonry veneer anchors and where indicated on Drawings.
- R. Miscellaneous Materials:
1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
 3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
 4. Cork Joint Filler: Resilient and non-extruding ASTM D1752, Type II.
 5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
 2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. Silicone Glazing Sealants: Refer to Section 08 80 00 - Glazing.
- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
 - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.
- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
 - 1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
 - 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
 - 3. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
 - 1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
 - 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and

intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

- I. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
 1. Extent of Testing: Test completed and cured sealant joints:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
 4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07 92 00

SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joint cover assemblies for floor, wall, ceiling, and soffit surfaces.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
 - 2. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board control joint trim.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.
 - 4. Section 09 51 00 - Acoustical Ceilings: Expansion joint assemblies in suspended ceiling grids.

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
- D. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.
- E. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2024.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples 6-inch long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Balco, Inc.: www.balcousa.com.
 - 2. Construction Specialties, Inc: www.c-sgroup.com.
 - 3. Watson Bowman Acme Corporation: www.watsonbowmanacme.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement (EJC-1):
 - 1. Basis of Design Manufactuer(s) and Product(s):
 - a. Balco, Inc; No-Bump Floor to Floor System, Aluminum (NBAF).
 - b. Construction Specialties, Inc; Allway Standard Metal Floor Covers.
 - c. Watson Bowman Acme Corporation; Wabo CorridorWrap Floor.
- B. Interior Floor Joints Subject to Seismic Movement (EJC-2):
 - 1. Basis of Design Manufactuer(s) and Product(s):
 - a. Construction Specialties, Inc; Allway Seismic Metal Floor Covers.
 - b. Watson Bowman Acme Corporation; Wabo Allure.
- C. Interior Wall/Ceiling Joints Subject to Thermal Movement (EJC-3):
 - 1. Basis of Design Manufactuer(s) and Product(s):
 - a. Balco, Inc; Wall and Ceiling Snap-On Joint Cover (WD).
 - b. Construction Specialties, Inc; Allway Standard Wall and Ceiling Covers.
- D. Interior Non-Fire-Rated Wall/Ceiling Joints Subject to Seismic Movement (EJC-4):
 - 1. Basis of Design Manufactuer(s) and Product(s):
 - a. Construction Specialties, Inc; Flush Seismic Wall and Ceiling Covers.

2.4 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 - 1. If floor covering is not indicated, obtain instructions from Architect before proceeding.

2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.
- D. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

2.5 MATERIALS

- A. Resilient Seals:
 1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
 2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
 3. Color: Gray.
- B. Anchors and Fasteners: As recommended by cover manufacturer.
- C. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- D. Threaded Fasteners: Aluminum.
- E. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Install expansion joints in accordance with TCA publication EJ171.
- C. Align work plumb and level, flush with adjacent surfaces.
- D. Rigidly anchor to substrate to prevent misalignment.

3.3 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION 07 95 13

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Provide items shown on the Drawings and specified, including, but not limited to the following:
 - 1. Standard steel doors for interior or exterior use.
 - 2. Acoustically-insulated steel doors for interior use.
 - 3. Opening protective steel doors for interior or exterior use.
 - 4. Thermally-insulated steel doors for interior or exterior use.
 - 5. Steel frames for doors, sidelites, transoms, and windows.
 - 6. Vision lites in steel doors.
 - 7. Sound rated steel doors.
 - 8. Thermally rated steel doors.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing.
 - 2. Section 07 92 00 - Joint Sealants.
 - 3. Section 08 80 00 - Glazing.
 - 4. Section 09 21 16 - Gypsum Board Assemblies.
 - 5. Section 09 24 00 - Cement Plastering.
 - 6. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes; 2018.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2024.
- F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- H. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- J. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- K. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- L. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- O. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):
 - a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
 - 1. 12 inch by 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
 - 2. 12 inch by 12 inch sample of each type of door louver specified or required, showing louver construction.
 - 3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.
- D. Certificates: Manufacturer's certification that oversized openings are in compliance with specifications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of 5 years' experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia, which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. Windstorm Resistance: Comply with ANSI A250.13.
- E. Structural Performance: Comply with ASTM E330/E330M.
- F. Air Leakage: Comply with ASTM E283/E283M.
- G. Regulatory Requirements:
 - 1. Fire-Rated Assemblies:
 - a. Opening protective door, panel, frame, and fire window construction shall conform to NFPA 252, or UL 10B, as applicable, and acceptable to the code of authorities having jurisdiction.
 - b. Opening Protective Door Construction:
 - 1) Notwithstanding any other requirements of this Section, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E); doors with B Label being 1-1/2 hour.
 - 2) Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above

ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.

c. Opening Protectives Hollow Metal Doors:

- 1) Conform to NFPA 80 for fire-rated class shown or required by code of authorities having jurisdiction:
 - (a) Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code of authorities having jurisdiction.
 - (b) Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
 - (c) Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.
 - (d) Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
 - (e) Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
 - (f) Caution shall be taken to ensure that labels are not removed, damaged, or painted over.
 - (g) Glass panes shall not exceed sizes allowed whether indicated or not on the Drawings.

2. Wind Loads:

- a. Provide hollow metal and door hardware assemblies approved by Authorities Having Jurisdiction (AHJ), including anchorage, capable of withstanding wind load design pressures calculated for this Project by a registered Engineer and are part of the construction documents.

H. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

- A. Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Use of incorrect materials in opening.
 2. Incorrect labeled components installed within opening.
 3. Noisy, rough, or difficult operation.
 4. Failure to meet specified quality assurance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage:
 1. Store under cover in a clean, dry place, protected from weather and abuse.
 2. Store in a manner that will prevent rust or damage.
 3. Store doors in a vertical position, spaced with blocking to permit air circulation.
 4. Do not use non-vented plastic or canvas shelters.
 5. Should containers or wrappers become wet, remove immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Ceco Door, an ASSA ABLOY company: www.cecodoor.com
 - 2. CURRIES, an ASSA ABLOY company: www.curries.com
 - 3. Pioneer Industries, Inc., an ASSA ABLOY company: www.pioneerindustries.com
 - 4. Republic Builders Products Company: www.republicdoor.com
 - 5. Steelcraft Mfg. Co., an Allegion company: www.steelcraft.com
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS, GENERAL

- A. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to A60 minimum coating weight standard per ASTM A653/A653M and ASTM A924/A924M, with coating weight of not less than 0.60 ounce per square foot (183 grams per square meter).

2.4 FRAME FABRICATION

- A. Minimum Gauges:
 - 1. Interior:
 - a. Openings less than 4 feet wide: 16 gauge.
 - b. Openings 4 feet in width and greater: 14 gauge.
 - 2. Exterior: 14 gauge.
- B. Design and Construction:
 - 1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least 4 inch (102 mm) wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch (121 mm) at 4 inch (102 mm) CMU, 6-3/4 inch (171 mm) at 6 inch (152 mm) CMU, and 8-3/4 inch (222 mm) at 8 inch (203 mm) CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch (51 mm) head member.
 - 2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
 - 3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.

4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch (16 mm), except at fire windows where minimum depth of stops shall be 3/4 inch (19 mm).
6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to the Owner's key system.
7. High-Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inches (1,219 mm) and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
9. 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.
10. Provide A60 galvanized coating at frames in the following locations:
 - a. Restrooms.
 - b. Kitchens / kitchen suites.
 - c. Locker rooms.
11. Electrical Knock Out Boxes:
 - a. Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Section 08 71 00 - Door Hardware:
 - 1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
 - 2) Provide electrical knock out boxes with 3/4 inch knockouts.
 - 3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
 - 4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Section 08 71 00 - Door Hardware.
 - 5) Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
 - 6) Provide field installed conduit per Division 28 - Electronic Safety & Security Section for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
12. Hardware Reinforcements:
 - a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4 inch (32 mm) by 10 inch (254 mm) minimum size): 7 gauge.
 - 2) Strike Reinforcements: 12 gauge stiffeners.
 - 3) Flush Bolt Reinforcements: 12 gauge.

- 4) Closer Reinforcements: 12 gauge.
- 5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12 gauge.
- 13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
- 14. Jamb Anchors:
 - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
 - 1) Frames up to 7 feet 6 inches (2,286 mm) in height: Three anchors.
 - 2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) in height: Four anchors.
 - 3) Frames over 8 feet (2,438 mm) in height: One anchor for each 2 feet (610 mm) or fraction thereof in height.
 - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to 7 feet 6 inches (2,286 mm) in height: Four anchors.
 - 2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) height: Five anchors.
 - 3) Frames over 8 feet (2,438 mm) in height: Four anchors plus one additional for each 2 feet (610 mm) or fraction thereof over 8 feet (2,438 mm).
 - c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
- 15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. 8 inch (203 mm) CMU walls with face brick shall have dual offset jamb anchors.
- 16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
- 17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
- 18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch (1.6 mm).
- C. Frame Color: Field paint under Section 09 90 00 - Painting and Coating, color as indicated on Drawings.

2.5 DOOR FABRICATION

- A. Minimum Gauges:
 - 1. Doors: 0.047 inch (1.2 mm) or 18 gauge (16 gauge for high frequency doors).
 - 2. 16 gauge (14 gauge for windstorm rated doors).
- B. Design and Construction:
 - 1. Thickness shall be 1-3/4 inches (44 mm), unless specifically noted or shown otherwise.
 - 2. Exterior doors: Provide doors with 22 gauge steel z-channels placed at 6 inches (152 mm) apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
 - 3. Fabrication:
 - a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
 - b. Corner bends shall be true, straight, and of minimum radius for gage of metal used.
 - c. Provide stiffeners with polystyrene core spaced maximum 6 inches on center and extending full height of door.
 - d. Fill interior with noncombustible fiberglass insulation. Use rock mineral wool board filler as required for labeled doors.

- e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
- f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
- g. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
- h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
- i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
- j. Edge profile shall be provided on both vertical edges of door as follows:
 - 1) Single-acting swing doors: Beveled 1/8 inch (3 mm) in 2 inches (51 mm) .
- k. Hardware Reinforcements:
 - 1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
 - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
 - (a) Hinge and pivot reinforcements: 7 gauge.
 - (b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
- 4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
- 5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
- 6. Edge Clearances:
 - a. Between door and frame at head and jambs: 1/8 inch (3 mm).
 - b. At doorsills with no threshold: 5/8 to 3/4 inch (16 to 19 mm) above finished floor.
 - c. At doorsills with threshold: As required to suit threshold.
 - d. Between meeting edges of double doors: 1/8 inch (3 mm).
- C. Finish:
 - 1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
 - a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
 - b. Chemically treat surfaces and apply 1 coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil (0.0127 mm) dry film thickness.
 - 2. Field painted under Section 09 90 00 - Painting and Coating.
- D. Sound Rated Door: STC as indicated in Door Schedule, measured in accordance with ASTM E413.
- E. Thermal Insulated Door: Total insulation R-Value as indicated in Door Schedule, measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

2.6 LABELED DOORS AND FRAMES

- A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested

and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.

- B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware, or other reason, the Architect shall be so advised before fabrication work on that item is started. Indicate and highlight on shop drawing.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate the work of this Section.
- B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00 - Door Hardware.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00 - Glazing.
- D. Coordinate doors and frames with painting specified in Section 09 90 00 - Painting and Coating.

3.2 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
 - 1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
 - 2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
 - 3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
 - 4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
 - 1. Install hardware in accordance with hardware manufacturer's templates and instructions.
 - 2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
 - 3. Adjust operable parts for correct function.
 - 4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.3 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION 08 11 13

SECTION 08 11 16 - ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior aluminum door and frame systems.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 08 14 16 - Flush Wood Doors.
 - 3. Section 08 80 00 - Glazing.
 - 4. Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCES STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's literature describing products to be provided.
- B. Shop Drawings:
 - 1. Submit shop drawings showing elevation of frames, profile, design construction details, methods of assembling sections, hardware locations, dimensions, anchorage and fastening methods, wall opening construction and finish requirements. Indicate location of each frame in Project.
 - a. Indicate location of each frame in Project.
 - b. Cross reference to Schedules.
- C. Samples:
 - 1. Submit four samples of frames showing selected finishes, corner joint, hinge reinforcement and anchors.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage experienced Installer who has completed installations of aluminum frames similar in design and extent to those required for project and whose work has resulted in construction with record of successful in-service performance.
- B. Manufacturer's Qualifications:

1. Provide aluminum framing systems produced by firm experienced in manufacturing systems that are similar to those indicated for this project and that have record of successful in-service performance.
- C. Single Source Responsibility:
 1. Obtain aluminum framing systems from one source and from single manufacturer.
- D. Design Criteria:
 1. Drawings indicate the size, profile and dimensional requirements of aluminum frames required and are based on specific types and models indicated.
 2. 60/90 minute rated frames shall be aluminum clad frames. Hollow metal not permitted.
- E. Regulatory Requirements:
 1. Installed frame and door assembly shall conform to NFPA 80 for fire rated class indicated.
 2. Where doors are noted with an hourly fire resistance rating, provide door and frame assemblies labeled by Underwriter's Laboratory, or any other testing laboratory approved by the local code authorities, to meet the hourly fire rating noted. Assemblies shall meet applicable building code requirements for positive pressure.
 3. Where an aluminum metal frame is used as a glazed opening in an interior fire rated wall assembly, the frame shall be labeled to match the fire rating required for a door assembly in the fire rated wall, except in a 1 hour fire rated corridor wall assembly, the glazed frame shall be labeled to a 45 minute rating. In a 1 hour fire rated corridor wall assembly, where the door frame is integral with the glazed frame, the frame shall have a 45 minute rating.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials in original unopened packaging with labels intact.
 2. Handle frames in a manner to prevent damage to finishes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Avalon International Aluminum, LLC: www.avalonint.com.
 2. Frameworks. Not desired.
 3. RACO Interiors: www.racointeriors.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 BASIS OF DESIGN PRODUCTS

- A. Acoustical Frames: Eagle Series manufactured by Avalon International Aluminum, LLC.

- B. Fire-Resistant-Rated Frames: Phoenix Series manufactured by Avalon International Aluminum, LLC.
- C. Classic Interior OfficeFronts System manufactured by RACO Interiors.

2.4 MATERIALS

- A. Aluminum Frames: Extruded aluminum
 - 1. Standard alloys shall conform to requirements published in AA ASD-1 and ASTM B221; 6063 T5 alloy.
 - 2. Thickness: 0.062 inch minimum.
 - 3. Finish: Thermal-setting powder coating / Class II clear anodized.
 - 4. Flush 1-1/2 inch or 2 inch face casing, extended lip strike not permitted.
 - 5. Throats or frames to be nominal wall thickness plus an 1/8 inch.
- B. Fire Rated Frames:
 - 1. Labeled frames shall be provided for those openings requiring a 20/45/60/90 minute fire protection rating as indicated on Drawings.
 - 2. Frames shall be constructed as tested and approved by Warnock Hersey Laboratories. Other nationally recognized testing agency having a periodical factory inspection service may be used subject to approval of authority having jurisdiction.
 - 3. Should any frame indicated to be fire rated not qualify for appropriate labeling because of its design, hardware, or any other reason, notify Architect before fabrication work on that frame is started.
- C. Doors: Manufacturer's standard glazed aluminum doors for manual-swing or sliding operation.
 - 1. Door Construction: 1-3/4 inch overall thickness, with extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that incorporate concealed tie bolts.
 - 2. Door Design: Wide Stile; 5 inch nominal width.
 - 3. Glazing Stops and Gaskets: Snap-on, extruded aluminum stops and preformed gaskets.
- D. Glass and Glazing Materials: Refer to Section 08 80 00 - Glazing.
- E. Fasteners: Provide fasteners of aluminum, non-magnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be non-corrosive and compatible with aluminum components, hardware, anchors and other components.
 - 1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
 - 2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

2.5 FABRICATION

- A. Frames:
 - 1. Frames shall be knock-down units consisting of separate header, strike and hinge jambs with snap-on casing, fabricated to sizes indicated on Drawings.
 - 2. Thickness of main frame members shall be increased to 0.130 inch minimum at frame and hinge anchorage.
 - 3. Frames shall be supplied with a notch at top of jamb and corner brackets to provide for correct alignment with header and add strength to joint.
 - 4. Stops shall be provided with a continuous nylon backed wool pile sound and light seal around perimeter.

5. Finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp, or buckle. Members shall be clean cut, straight and of uniform profile throughout their lengths.
6. Frames shall be pressure fit type that are installed after partition is in place. Frames shall be anchored at bottom of each jamb. Additional anchors shall be furnished per manufacturer's recommendations.
7. Glazing frames shall be provided with snap-in type stops with manufacturer's standard neoprene gaskets. Glass installed adjacent to metal without intervening gasket shall not be allowed. Door jambs with integral glazing shall have reinforcement channel. Intermediate mullions shall maintain 1-1/2 inch profile.
8. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.
9. Uniformity of Metal Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample per submittal.
10. Fasteners: Exposed fasteners not permitted.

2.6 FINISHES

- A. Shop Applied Finish:
 1. Remove die markings prior to finishing operations. Perform this work in addition to finish specified. Scratches, abrasions, dents and similar defects are not acceptable.
 2. Color: Powder coating, color to be selected by Architect.
- B. Thermal-Setting Powder Coatings:
 1. Aluminum frames shall have shop applied finish with a thermal-setting powder coating applied in compliance with AAMA 605.2. Finish system shall have a minimum dry film thickness of 1.8 mil applied over a seven stage aluminum pre-treatment.
 2. Colors: Manufacturer's standard color or custom color to match control sample provided by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Frames:
 1. Prior to installation rough openings shall be checked and corrected for size, squareness, alignment and plumbness.
 2. Slip header and jambs into rough opening, allowing header to rest on jambs. Align to scheduled opening width and height, achieving equal wall capture at both jambs.
 3. Check level of header and squareness and plumb of jambs. Measure width at each hinge location.
 4. Attach flat corner angles at faces of head. Anchor jambs and header in legs of frame at top and bottom of jambs and at approximately 15 inches on center.
 5. Install mitered trims by snapping over receiver tabs and lightly tapping with a rubber mallet.
- B. Tolerances:
 1. Squareness: + 1/16 inch.
 - a. Measured on a line 90 degree from one jamb, at upper corner of frame at other jamb.
 2. Alignment: + 1/16 inch.
 - a. Measured on jambs on a horizontal line parallel to plane of wall.
 3. Twist: + 1/16 inch.
 - a. Measured at face corners of jambs on parallel line.
 4. Plumbness: + 1/16 inch.
 - a. Measured on the jamb at floor.

3.2 ADJUSTING

- A. Final Adjustments:
 - 1. Check and re-adjust operating finish hardware just prior to final inspection and after painting hinges.
 - 2. Remove and replace defective work.

3.3 CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation complying with requirements contained in Section 08 80 00 - Glazing for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.
- C. Door opening assemblies shall be cleaned with general, non-abrasive cleaners suitable for painted surfaces. Wipe the surfaces with a soft, dry cloth per AAMA 609 & 610.

3.4 PROTECTION

- A. Institute protective measures required throughout remainder of construction period to ensure that aluminum frames will be without damage or deterioration, other than normal wear at time of acceptance.

3.5 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 - 1. Maintenance tools and instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 - 2. Initial maintenance service: Beginning at Substantial Completion, provide six (6) months full maintenance by skilled employees of entrance door hardware installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 11 16

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SECTION 08 13 16 - ALUMINUM DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Swing doors systems.
 - 2. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- E. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- F. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- J. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance: Aluminum-framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.

- B. Structural Loads: Verify with Structural Engineer
 - 1. Wind Loads: As indicated on Drawings.
- C. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch (19 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch (3.2 mm), whichever is less.
- D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E283/E283M at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Windborne Debris Impact Resistance: Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone 3.
 - 1. Large Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
 - 2. Small Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.
- H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 - 2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).
- I. Condensation Resistance: Provide exterior aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings: Submit aluminum-framed storefront and entrance shop drawings including plans, elevations, sections, full size details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Door Hardware: Coordinate with Section 08 71 00 - Door Hardware.
- D. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- B. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- D. Source Limitations: Obtain aluminum-framed storefronts and entrances from single source from single manufacturer to the greatest extent possible.
- E. Pre-Installation Conference: Conduct conference at site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components.
 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 20 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Kawneer Company, Inc: www.kawneer.us.
 2. Old Castle Building Envelope.
 3. Tubelite, Inc.
 4. US Aluminum Corporation.
 5. Vistawall.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

- A. Basis of Design:
 1. Impact-Resistant Exterior Doors: "Insulpour 500 IR" manufactured by Kawneer.
 2. Thermal Doors: "Insulpour 500 T" manufactured by Kawneer.
 3. Non-Thermal Doors: "500 Standard Entrance" manufactured by Kawneer.
- B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B209/B209M.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 4. Structural Profiles: ASTM B308/B308M.
- C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
 1. Construction: Thermally broken for exterior conditions, non-thermal for interior conditions, unless noted otherwise.
 2. Glazing System: Retained mechanically with gaskets on four sides.

- D. Accessories:
 - 1. Brackets and Reinforcements: High-strength aluminum with non-staining, non-ferrous shims for aligning system components.
 - 2. Fasteners and Accessories: Corrosion resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
 - 3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
 - 4. Concealed Flashing: Corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
 - 5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.
- E. Glazing: Refer to Section 08 80 00 - Glazing.
 - 1. Exterior Doors: Provide with insulating glazing units.
 - 2. Interior Doors: Provide with tempered glazing.
 - 3. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 - 4. Spacers and Setting Blocks: Elastomeric type.
- F. Doors: Glazed doors for manual swing operation.
 - 1. Door Construction:
 - a. Impact Resistant Doors: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - b. Thermal Doors: 2-1/4 inch (57.2 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - c. Non-Thermal Doors: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Wide stile; 5 inch (88.9 mm) nominal width.
 - 3. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 - 4. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.
- G. Door Hardware: Refer to Section 08 71 00 - Door Hardware for door hardware sets.
- H. Accessories:
 - 1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
 - 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.4 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 8. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide weather stripping, sweeps, and accessible thresholds.
 2. At interior doors, provide gasketing to prevent metal to metal contact.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ALUMINUM FINISHES

- A. Factory Finish: Finish to match storefront, window wall, or curtain wall system in which entry system is installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
1. Do not install damaged components.
 2. Fit joints to produce hairline joints free of burrs and distortion.
 3. Rigidly secure non-movement joints.
 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

- D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Section 08 80 00 - Glazing.
- G. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 13 16

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SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. WI Certified, fire-rated and non-rated, flush panel wood doors.
 - 2. Solid core doors with MDF and plastic laminate faces.
 - 3. Integration of a security system.
 - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 5. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 07 92 00 - Joint Sealants.
 - 3. Section 08 11 13 - Hollow Metal Doors and Frames.
 - 4. Section 08 80 00 - Glazing.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 09 24 00 - Cement Plastering.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- C. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- E. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Technical data for each type of door indicated:
 - a. Include details of core and edge construction, louvers, and trim for openings.
 - b. Include factory finishing specifications.
 - c. Include laboratory test report results of hinge loading, cycle/slam, stile edge screw withdrawals, and stile edge split resistance for fire rated doors.
- B. Shop Drawings:
 - 1. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - a. Dimensions and locations of blocking.
 - b. Dimensions and locations of mortises and holes for hardware.

- c. Dimensions and locations of cutouts.
 - d. Undercuts.
 - e. Requirements for veneer matching.
 - f. Doors to be factory finished and finish requirements.
 - g. Fire-protection ratings for fire rated doors.
- C. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for fire rated door assemblies and smoke and draft control door assemblies.
- D. Certificate of Compliance regarding WI construction grade.
- E. Certificate of Compliance regarding WI installation requirements.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
- 1. Fire rated wood doors - NFPA 80 listed and labeled by UL for fire protection ratings indicated, based on testing at positive pressure according to UL 10C:
 - a. Oversize fire rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - b. Temperature rise limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
 - 2. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
 - 3. Accessibility requirements - comply with applicable requirements:
 - a. Americans with Disabilities Act of 1990, as amended:
 - 1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
 - 4. Quality standard: In addition to requirements specified, comply with Woodwork Institute WI Manual of Millwork
 - 5. Maintain at least one copy of WI Manual for reference at jobsite throughout installation period.
- B. Source Limitations: Obtain flush wood doors through one (1) source from a single manufacturer.
- C. Pre-Installation Conference: Conduct conference at site.

1.6 WARRANTY

- A. Warranty:
- 1. Written warranty signed by manufacturer, installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship. A representative of the door manufacturer shall inspect the installed doors and shall note on the warranty that no provisions of the warranty have been nullified in the manufacture and/or installation:
 - a. Failures include, but are not limited to, the following:
 - 1) Warping (bow, cup, or twist) more than 1/4-inch (6.4 mm) in a 42-inch by 84-inch (1,067 mm by 2,134 mm) section.
 - 2) Telegraphing of core construction in face veneers exceeding 0.01-inch in a three-inch (0.25 mm in a 76.2 mm) span.
 - b. Warranty include installation and finishing that may be required due to repair or replacement of defective doors.
 - c. Warranty period for solid core exterior doors: Five (5) years from date of Substantial Completion.

- d. Warranty period for solid core interior doors: Life of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Store wood doors on a flat level surface in a dry, well ventilated, place. Keep wood doors a minimum of 3-1/2 inches (85 mm) off floor surface and protected by a protective covering under the bottom door and over the top door. Covering should protect wood doors from dirt, water, and abuse but allow for air circulation under and around the stack. Do not store wood doors in direct sunlight. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in heavy duty cardboard cartons prior to shipment from factory. Mark each door on top and bottom rail with opening number used on shop drawings using temporary, removable, or concealed markings.
- C. Handle wood doors with clean gloves. Lift and carry wood doors when moving them around the site; do not drag wood doors across one another.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Flush Wood Doors:
 - a. Haley Brothers, Inc.
 - b. Oshkosh Door Company.
 - c. Oregon Door.
 - d. Weyerhaeuser.
 - 2. High Pressure Laminate:
 - a. Formica Corp.
 - b. Panolam Surface Systems.
 - c. Wilsonart LLC.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

- A. 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. Cores: Provide core specified or mineral core as necessary to provide fire protection rating indicated.

2. Edge construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 3. Pairs: Provide fire retardant stiles 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.
 4. Pairs:
 - a. Provide formed steel edges and astragals with intumescent seals:
 - 1) Finish steel edges and astragals with baked enamel same color as doors.
 - 2) Finish steel edges and astragals to match door hardware (locksets or exit devices).
- B. Smoke and Draft Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- C. Particleboard Core Doors:
1. Blocking:
 - a. Provide wood blocking in particleboard core doors as necessary to eliminate through-bolting hardware:
 - 1) Five-inch (125 mm) top rail blocking in all doors, whether or not closers are scheduled.
 - 2) Five-inch (125 mm) bottom rail blocking, in exterior doors and doors indicated to have protection plates.
 - 3) Five-inch (125 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
 2. Provide doors with glued wood stave or structural composite lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- D. Fire Rated Wood Doors with Plastic Laminate Face - 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. Core: Noncombustible mineral product complying with requirements and testing and inspecting agency for fire protection rating indicated.
 2. Blocking:
 - a. Provide composite blocking with improved screw-holding capability approved for use in doors of fire protection ratings indicated as follows:
 - 1) 5 inch (127 mm) top rail blocking in all doors, whether or not closers are scheduled.
 - 2) 5 inch (127 mm) bottom rail blocking, in doors indicated to have protection plates.
 - 3) 5 inch (127 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 by 10 inch (114 by 254 mm) lock blocks, in doors indicated with lock and latch sets.
 3. Edge Construction:
 - a. Provide fire rated door edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges:
 - 1) At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance:
 - (a) Screw holding capability: 550 lbf (2440 N) per WDMA T.M.-10.
 - 2) Pairs:
 - (a) Provide fire retardant stiles 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.

Where required, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

4. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

2.4 PLASTIC-LAMINATE-FACED DOORS

A. Particleboard Core Doors with Plastic Laminate Face:

1. Grade and Construction: WI custom grade, PC-5; 1-3/4 inch (44.4 mm) unless otherwise indicated.
2. Core: ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
3. Blocking:
 - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
 - 1) 5 inch (127 mm) top rail blocking, in all doors, whether or not closers are scheduled.
 - 2) 5 inch (127 mm) bottom rail blocking in doors indicated to have protection plates.
 - 3) 5 inch (127 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 by 10 inch (114 by 254 mm) lock blocks, in doors indicated with lock and latch sets.
4. Construction: Five plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
5. Crossbanding: Minimum 1/16 inch (1.6 mm) thick, low density hardwood, composite, or high density hardboard.
6. Face: 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL).
 - a. Finish: PL-_____.
7. Exposed Vertical and Horizontal Edges:
 - a. Material: Plastic Laminate.
 - b. Finish: Match Face.

2.5 WOOD VENEER-FACED DOORS (TRANSPARENT FINISH)

A. Particleboard Core Doors with Wood Veneer Face:

1. Grade and Construction: WI custom grade, PC-5; 1-3/4 inch (44.4 mm) unless otherwise indicated.
2. Core: ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
3. Blocking:
 - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
 - 1) 5 inch (127 mm) top rail blocking, in all doors, whether or not closers are scheduled.
 - 2) 5 inch (127 mm) bottom rail blocking in doors indicated to have protection plates.
 - 3) 5 inch (127 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 by 10 inch (114 by 254 mm) lock blocks, in doors indicated with lock and latch sets.
4. Construction: Five plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
5. Crossbanding: Minimum 1/16 inch (1.6 mm) thick, low density hardwood, composite, or high density hardboard.

6. Face: Wood Veneer.
 - a. Species: _____.
 - b. Cut: _____.
 - c. Matching: _____.
 - d. Finish: As selected by the Architect from manufacturer's full line.
7. Exposed Vertical and Horizontal Edges:
 - a. Material: _____.
 - b. Finish: _____.

2.6 PAINTED DOORS (OPAQUE FINISH)

- A. Particleboard Core Doors with Painted Finish:
 1. Grade and Construction: AWI custom grade, PC-5; 1-3/4 inch (44.4 mm) unless otherwise indicated.
 2. Core: ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
 3. Blocking:
 - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
 - 1) 5 inch (127 mm) top rail blocking in all doors, whether or not closers are scheduled.
 - 2) 5 inch (127 mm) bottom rail blocking in doors indicated to have protection plates.
 - 3) 5 inch (127 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 by 10 inch (114 by 254 mm) lock blocks, in doors indicated with lock and latch sets.
 4. Exposed Vertical and Horizontal Edges:
 - a. Material: Painted MDF.
 - b. Painted MDF: Match face.
 5. Construction: Five plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
 6. Crossbanding: Minimum 1/16 inch (1.6 mm) thick, low density hardwood, composite, or high density hardboard.
 7. Face: Paint grade medium density overlay (MDO).

2.7 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint with baked-enamel or powder-coated finish, and approved for use in doors of fire-protection rating indicated.
- C. Metal Louvers:
 1. Manufacturers are subject to compliance with requirements; provide products by one of the following:
 - a. Air Louvers; a Division of the Activar Construction Products Group.
 - b. L & L Louvers.
 - c. McGill Architectural Products.
 2. Blade Type: Vision-proof, inverted V.
 3. Metal and finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint with baked-enamel or powder-coated finish.
 4. Metal and finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.

- D. 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 are subject to compliance with requirements; provide products by one of the following:
 - a. [Air Louvers; a Division of the Activar Construction Products Group.](#)
 - b. [L & L Louvers, Inc.](#)
 - c. [McGill Architectural Products.](#)
 - d. Approved equal.
 - 2. Metal and Finish: Hot-dip galvanized steel, 0.040-inch (1.0 mm) thick, factory primed for paint with baked-enamel or powder-coated finish.

2.8 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 NFPA 80 requirements 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, BHMA-156.115-W, and hardware templates:
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels:
 - 1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles:
 - a. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings:
 - 1. Factory cut and trim openings through doors:
 - a. Light openings: Trim openings with moldings of material and profile indicated.
 - b. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 - Glazing.
 - c. Louvers: Factory install louvers in prepared openings.
- E. Exterior Doors:
 - 1. Factory treat exterior doors with water repellent after fabrication has been completed but before shop priming or factory finishing:
 - a. Flash top of out-swinging doors with manufacturer's standard metal flashing.

2.9 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 09 90 00 - Painting and Coating.
- B. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 90 00 - Painting and Coating. Seal edges of cutouts and mortises with first coat of finish.

2.10 FACTORY FINISHING

- A. General: For factory finish doors, factory finish doors that are indicated to receive transparent finish, and factory finish doors where indicated in schedules or on Drawings as factory finished:

- a. 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. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WI's Architectural Woodwork Standards System 9, UV curable, acrylated epoxy, polyester, or urethane; refer to Drawings for finish designation.
 - 3. Staining: As selected by the Architect from manufacturer's full range.
 - 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
 - 5. Sheen: Semigloss.
- C. Opaque Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWMAC's and WI's Architectural Woodwork Standards System 10, UV curable, water based; refer to Drawings for finish designation.
 - 3. Color: As selected by the Architect from manufacturer's full range.
 - 4. Sheen: Semigloss.

PART 3 EXECUTION

3.1 FIELD 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 remainder of construction period.

3.2 EXAMINATION

- A. Examine doors and installed door frames, with installer present, before hanging doors:
 - 1. Verify that installed 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.

3.3 INSTALLATION

- A. Hardware: For installation, refer to Section 08 71 00 - Door Hardware.
- B. Installation Instructions:
 - 1. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated:
 - a. Install fire-rated doors according to NFPA 80.
 - b. Install smoke and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining:
 - a. Clearances:
 - 1) Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 3/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4

inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated:

- (a) Comply with NFPA 80 for fire-rated doors.
- b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
- c. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.4 ADJUSTING

- A. Operation: Rehang 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 08 14 16

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SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall- and ceiling-mounted access units.
 - 2. Floor-mounted access door and frame units, interior and exterior.
 - 3. Sliding monorail access door and frame units.
 - 4. Flood protection door and frame units.
 - 5. Flood protection plank and frame units.
- B. Related Sections
 - 1. Section 08 71 00 - Door Hardware: Mortise cylinder and core hardware.
 - 2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- C. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2025.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- F. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- I. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- K. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- L. FM (AG) - FM Approval Guide; Current Edition.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Samples: Submit two access units, 6 by 6 inches (150 by 150 mm) in size indicating frame configuration.

- E. Manufacturer's Installation Instructions: Indicate installation requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Project Record Documents: Record actual locations of each access unit.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Wall and/or Ceiling Access Units:
 - a. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - b. ACUDOR Products Inc: www.acudor.com.
 - c. BAUCO Access Panel Solutions Inc.: www.accesspanelsolutions.com.
 - d. Best Access Doors: www.bestaccessdoors.com.
 - e. BILCO Company: www.bilco.com.
 - f. Cendrex, Inc: www.cendrex.com.
 - g. Elmdor: www.elmdor.com.
 - h. FF Systems, Inc: www.ffsystemsinc.com.
 - i. MIFAB, Inc: www.mifab.com.
 - j. Milcor, Inc: www.milcorinc.com.
 - k. Nystrom, Inc: www.nystrom.com.
 - l. Studco Building Systems: www.studcosystems.com.
 - m. Williams Brothers Corporation of America (The): www.wbdoors.com.
 - 2. Floor-Mounted Access Units:
 - a. Babcock-Davis: www.babcockdavis.com.
 - b. BILCO Company: www.bilco.com.
 - c. Cendrex, Inc: www.cendrex.com.
 - d. Karp Associates, Inc: www.karpinc.com.
 - e. Nystrom, Inc: www.nystrom.com.
 - 3. Sliding Monorail Opening Access Units:
 - a. PS DOORS: www.psdors.com.
 - 4. Flood Protection Doors:
 - a. PS DOORS: www.psdors.com.
 - 5. Flood Protection Planks:
 - a. PS DOORS: www.psdors.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:

- a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 ACCESS DOOR AND PANEL ASSEMBLIES

- A. General:
 1. The following access panel types are for selection as required whether or not indicated on Drawings. The Contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.
 2. Location: As indicated on Drawings or as required to access building systems.

2.4 WALL AND/OR CEILING ACCESS UNITS

- A. Wall and Ceiling Units for Gypsum Board
 1. Basis of Design:
 - a. WB RDE 410 manufactured by The Williams Bros. Corporation of America.
 2. Door: 14 gauge steel with 5/8 inch (16 mm) 5/8" recess to accommodate gypsum board panel.
 3. Size: As indicated on Drawings
 4. Frame: 16 gauge steel.Casing Bead:
 5. Casing Bead: 1 inch (25 mm) 1" wide, perforated 24 gauge galvanized flange.
 6. Finish: Baked enamel.
 - a. Color: White.
 7. Latch: Flush, stainless steel cam.
 8. Hinged: Fully-concealed, pivot-rod hinge allowing opening to 180 degrees.
- B. Fire-Rated, Wall-Mounted and Ceiling Mounted Units:
 1. Basis of Design Product:
 - a. WB FR 800 Series manufactured by The Williams Bros. Corporation of America.
 2. Description: Fire rated access panel designed for use in walls and ceilings where fire resistance is required.
 3. Frame: 16 gauge steel frame.
 4. Door: 2-1/2 inches deep, 20 gauge steel door.
 5. Finish: Primed white baked enamel finish.
 6. Hinges: Fully concealed, pivot rod hinge to allow for 140 degree opening.
 7. Latching: Self-latching slam catch.Provide spring closer for vertical applications.
 8. Mounting: Provide surface-mounted face frame and door surface flush with wall surface.
 9. Size: As indicated on Drawings or as required for proper access.
- C. Wall-Mounted Units for Tile:
 1. Basis of Design Product:
 - a. WB DWAL 414 manufactured by The Williams Brothers Corporation of America.
 2. Description: Recessed access door/panel with touch latches for tile application.
 3. Material: Aluminum.
 4. Door: Fully detachable.
 5. Hinges: Concealed.
 6. Recess Depth: As required for tile.
 7. Size: As indicated on Drawings or as required for proper access.

8. Tile: As indicated on Drawings.
- D. Wall and Ceiling Mounted Units in Wet Areas:
 1. Basis of Design Product:
 - a. WB AL 1600 Series manufactured by The Williams Brothers Corporation of America.
 2. Description: General use access panel designed for use where moisture is a concern for use in walls and ceilings.
 3. Frame: Aluminum.
 4. Cover: 0.063 lightweight aluminum with radius corners.
 5. Hinges: Continuous Piano Hinge to allow for 180 degree opening.
 6. Finish: Primed white baked enamel finish
 7. Latch: Self latching.
 8. Mounting: Provide surface-mounted face frame and door surface flush with wall surface.
 9. Size: As indicated on Drawings or as required for proper access.

2.5 FLOOR-MOUNTED ACCESS UNITS

- A. Non-Fire-Rated Access Door:
 1. Basis of Design:
 - a. Type K or KD, as indicated on Drawings, manufactured by The BILCO Company.
 2. Description: General duty access panel designed for use in walls and ceiling.
 3. Material: 1/4 inch (6 mm) aluminum cover and extruded aluminum frame.
 4. Frame: Extruded aluminum angle frame with strap anchors bolted around perimeter.
 5. Cover: Diamond-pattern tread plate reinforced for 150 psf (732 kg/sq. m) live load.
 6. Hinges: Concealed, cast-steel, cam-action.
 7. Latch: Type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle.
 8. Lift Assistance: Torsion bars that pivot on cam-action hinges with automatic hold-open arm with grip handle release.
 9. Finish: Mill.
 10. Hardware: Manufacturer's standard.
 11. Size: As indicated on Drawings or as required for proper access.
- B. Interior Floor-Mounted Access Units:
 1. Description: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 2. Basis of Design Product:
 3. Design Load: Design to support live load of 150 psf (7.2 kPa) with deflection not to exceed 1/180 of span.
 4. Operation: Manual opening, and manual closing.
 5. Frame Configuration: Drainage channel with drain coupling.
 6. Cover Pattern: Diamond tread plate. Cover with custom lettering; 1/8 inch (3.2 mm) deep recess with edge molding.
 7. Lift Handle: Recessed, removable.
 8. Hardware: Steel, hot-dipped galvanized.
 9. Finish: Rust inhibiting primer.
 10. Size: As indicated on drawings.

2.6 SLIDING MONORAIL OPENING ACCESS UNITS

- A. Basis of Design:
 1. Paired Swing Monorail Door manufactured by PS DOORS.
- B. Sliding Monorail Opening Access Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp;

unitized structural track and frame assembly; coordinate requirements with type of installation assembly being used for each unit.

1. Door Size: As indicated on Drawings.
2. Door Type: Bi-parting sliding doors, with insulated double wall construction.
3. Sliding doors to operate on high capacity, spark-less, non-corrosive type rollers with greasable bearings and seals.
4. Door Hardware: Provide manufacturer's standard hardware for application indicated with weather-sealed perimeter and latching joint.
5. Busbar and Monorail Notch: Sized to allow doors to close and fully seal around monorail beam upon closing.

2.7 FLOOD PROTECTION DOORS

- A. Basis of Design:
 1. Single Pedestrian Flood Door, Model PD-520 manufactured by PS DOORS..
- B. Flood Protection Doors: Provide FM (AG) approved barriers against short-term high water levels with factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly indicated for each unit.
 1. Door Type: Single swing flood door.
 2. Flood Door Material:
 - a. Steel: Structural or formed steel shapes and bars, ASTM A36/A36M; structural tubing, ASTM A500/A500M Grade B, or mechanical tubing, ASTM A513/A513M; of appropriate size and strength with welded construction.
 - 1) Finish: One primer and two finish shop coats, applied in accordance with manufacturer's instructions.
 3. Panel Sheeting Material:
 - a. Steel: ASTM A36/A36M, ASTM A1008/A1008M, and ASTM A1011/A1011M welded in place.
 - 1) Finish: One primer and two finish shop coats, applied in accordance with manufacturer's instructions.
 4. Frame Material: Provide jamb, head, and sill framing members designed and fabricated with fasteners, sealant, and water stop as required for loading and application indicated.
 - a. Steel: Structural or formed steel shapes, ASTM A36/A36M; of appropriate size and strength with welded construction.
 5. Threshold: ASTM B26/B26M sand cast aluminum with alloy 6063 and temper T5, raised sill.
 6. Door Hardware: Provide manufacturer's standard hardware, factory located and prepared, for application indicated with water-sealed perimeter and latching hardware.

2.8 FLOOD PROTECTION PLANKS

- A. Basis of Design Product:
 1. Flood Plank, Model FP-530 manufactured by PS DOORS.
- B. Flood Protection Planks: Factory-fabricated flood plank, face frame, and gasket system tested to meet FM (AG) flood mitigation product approval standards; coordinate requirements with type of installation assembly indicated for each unit.
 1. High Water Protection Level: As indicated on drawings.
 2. Operation: Provide latching from single side only, as indicated on drawings.
 3. Mounting: Face-mounted as indicated on drawings.
 4. Frame: Provide mechanically anchored type frame system, and include fasteners, water-stop, and sealants as required for transfer of hydrostatic pressure and other loading of specified system.

5. Loading Direction: Positive pressure loading against planks to compress seals, seated type.
6. Plank Height: 6 inches (152 mm), nominal.
7. Plank Material: ASTM B209/B209M aluminum with alloy 6061 and temper T6, with welds ground smooth.
 - a. Finish: Mill, factory acid washed, neutralized and rinsed.
8. Sill Option: Surface-mounted Type 304 stainless steel plate sill.
9. Gaskets: Provide factory-mounted, ultraviolet-resistant EPDM, and field-replaceable compressible gaskets on flood protection planks assembly; gaskets shall not be inflatable type.
10. Door Hardware: Provide manufacturer's standard hardware, factory located and prepared, for application indicated with water-sealed jambs and sill.
11. Provide rectangular door opening with square corners within flood protection plank system for easy passage.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

SECTION 08 42 43 - INTENSIVE CARE UNIT / CRITICAL CARE UNIT ENTRANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packaged units consisting of doors, sidelights, frames, and hardware; manual operation.
 - 2. Packaged units consisting of doors, sidelights, frames, and hardware; automatic operation.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Connection of frame to building ground.

1.2 DEFINITIONS

- A. SX Panel: Sliding panel that swings open upon pushing.
- B. SO Panel: Sidelight panel, normally stationary, that will swing open upon pushing.
- C. X Panel: Sliding panel unable to swing.
- D. O Panel: Sidelight panel unable to swing.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- G. BHMA A156.10 - Power Operated Pedestrian Doors; 2024.
- H. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's catalog data, detail sheets, and specifications, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Specimen warranty.
- C. Shop Drawings: Prepared specifically for this project; show dimensions of doors, sidelights, details of construction, and interface with other products.
- D. Samples: Two color cards 6 inches (150 mm) square or larger, showing manufacturer's full range of available colors and patterns for each product specified.
- E. Samples: Two samples, each minimum size 6 inches (150 mm) square, showing actual product, color, and patterns for each finish product specified.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Operating and Maintenance Data: Operating and maintenance instructions, and parts lists.
- I. Specimen warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Provide ICU/CCU entrances from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in factory packaging, protected from damage.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store products under cover and elevated above grade.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Manually-Operated ICU/CCU Entrance Door Assemblies:
 - 2. Power-Operated ICU/CCU Entrance Door Assemblies:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 ENTRANCE DOORS ASSEMBLIES

- A. Basis of Design
 - 1. Manually-Operated ICU/CCU Entrance Door Assemblies:
 - 2. Power-Operated ICU/CCU Entrance Door Assemblies:
- B. Entrance Assemblies: Factory assembled, power-operated, extruded aluminum door and frame with normally-closed but operable sidelights, complete with hardware and operating components.
 - 1. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
 - a. Door Thickness: 1-3/4 inch (44.5 mm), nominal.

2. Accessible Door Opening Force: Maximum of 5 pound-force (22.2 N) to fully open door in compliance with ADA Standards and requirements of local authorities having jurisdiction.
3. Panel Breakout Force: Maximum of 50 pound-force (222 N).
4. Finish: Clear anodized, AAMA 611 Class I; in compliance with NAAMM AMP 500-06.
5. Antimicrobial Finish: Provide EPA-approved silver-based antimicrobial coating on exposed metal parts, including door handles.
6. Electrical Grounding: Provide internal grounding of entrances in compliance with authorities having jurisdiction, refer to Section 26 05 26 for additional requirements.

C. Dimensions:

1. Rough Opening Width: As indicated on Drawings.
2. Overall Frame Width (Outside): As indicated on Drawings.
3. Clear Opening Width: As indicated on Drawings, when swinging panels are fully open.
4. Normal Operation Opening Width: As indicated on Drawings.
5. Maximum Panel Width: As indicated on Drawings.
6. Rough Opening Height: As indicated on Drawings.
7. Overall Frame Height: As indicated on Drawings.
8. Clear Door Opening Height: As indicated on Drawings.
9. Framing Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
 - a. Nominal Sizes: 1-3/4 inch (44.5 mm) wide by 4-1/2 inch (114.3 mm) deep.
 - b. Concealed Fastening: Provide concealed fastening pocket in framing, with continuous flush insert cover extending full length of each framing member.
10. Panel Thickness: 1-3/4 inch (45 mm).
11. Stile Design:
12. Top Rail Height: 4 inch (102 mm), nominal.
13. Intermediate Rail (Muntin Bar) Height: 2 inch (51 mm), nominal.
14. Bottom Rail Height: 4 inch (102 mm), nominal.
15. Glazing Stop Width: Manufacturers standard.
16. Glazing Thickness: 1/4 inch (6 mm).

D. Standards Compliance for Automatic Operation Doors:

2.4 COMPONENTS

- A. Aluminum Extrusions for Doors, Sidelights, Headers, and Trim: Alloy as recommended by manufacturer for construction and specified finish; nominal 1/8 inch (3.2 mm) wall thickness.
- B. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.

2.5 CONTROLLERS, ACTUATORS, AND SAFETIES FOR POWER-OPERATED DOORS

- A. Controller: Provide microprocessor-operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings are plumb, square, and ready for installation of entrances.
- B. Verify that overhead support is properly located and securely anchored.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Where aluminum components will contact different metals, prior to installation paint contact surfaces with primer or apply sealant or tape recommended by manufacturer for protection against galvanic action.
- D. Where aluminum components will contact concrete or masonry, prior to installation paint contact surfaces with bituminous paint.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, except where more stringent requirements are specified.
- B. Install entrances securely anchored in place, plumb, level, and true to location, in alignment with established lines and grades, without warp, bow, or racking of members.
- C. Where frames are assembled in field, fit frame joints hairline tight without burrs or distortion; rigidly secure nonmoving joints and seal watertight.
- D. Install field-installed hardware using concealed fasteners to greatest extent possible.

3.4 ADJUSTING

- A. Adjust entrances for correct function and smooth operation, without binding or scraping and without excessive noise; lubricate operating hardware and other moving parts.

3.5 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Remove temporary protection; clean exposed surfaces.

3.6 COMMISSIONING

- A. Commissioning: Refer to Section 01 91 13 - General Commissioning Requirements.
- B. Test electrical grounding for compliance with requirements of authorities having jurisdiction.

3.7 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for additional submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate operation of equipment to Owner's designated personnel.

3.8 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 08 42 43

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Exterior and interior storefront framing.
 - 2. Exterior and interior manual swing entrance doors.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing.
 - 2. Section 05 40 00 - Cold Formed Metal Framing.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 07 62 00 - Roof Related Sheet Metal.
 - 5. Section 07 92 00 - Joint Sealants.
 - 6. Section 08 13 16 - Aluminum Doors.

1.3 REFERENCE STANDARDS

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- M. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

- N. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).
- O. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- P. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- R. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- S. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- T. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings:
 - 1. Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other work:
 - a. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - b. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Engineer's calculations of performance requirements.
- E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

- A. Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or fail due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Structural Loads:
 - 1. Wind loads: _____ Ultimate wind speed gust 115 mph; exposure D.

- C. Deflection of Framing Members:
 - 1. Deflection normal to wall plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 - 2. Deflection parallel to glazing plane: Limited to $L/360$ of clear span or 1/8 inch (3.2 mm), whichever is smaller.
- D. Structural Test Performance - Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E331 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Windborne Debris Impact Resistance:
 - 1. Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone _____:
 - a. Large missile test: For glazed openings located within 30 feet (9.1 m) of grade.
- H. Thermal Movements:
 - 1. Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
 - a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 - b. Interior ambient-air temperature: 75 degrees F (24 degrees C).
- I. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility requirements:
 - a. 2019 California Building Code: Section 11B-404.3 accessible route.
 - b. 2019 California Building Code: Section 11B-309.4 operable parts interior usage.
 - c. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - d. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

- B. Installer Qualifications: Installer having minimum 10 years' documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options:
 - 1. Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance:
 - a. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.
- F. Pre-Installation Conference: Conduct conference at site.

1.7 WARRANTY

- A. Written warranty signed by manufacturer, Contractor, and installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components.
 - 2. Warranty period: 2 years from date of Substantial Completion.
- B. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering:
 - 1. Warranty period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactureres:
 - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Kawneer: www.kawneer.us.
 - b. Oldcastle BuildingEnvelope: www.obe.com.
 - c. Tubelite, Inc.: www.tubeliteusa.com.
 - d. US Aluminum Corporation: www.usalum.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:

Aluminum-Framed Storefronts

1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 ALUMINUM-FRAMED STOREFRONT SYSTEMS

- A. Basis of Design:
 1. Standard Systems:
 - a. Trifab VersaGlaze 451 manufactured by Kawneer.
 2. Impact Resistant Systems:
 - a. Trifab 601 and 601T manufactured by Kawneer.
- B. General:
 1. Maximum design pressure +/- 45 psf.
 2. Refer to Drawings for frame size and locations. Subject to compliance with requirements, provide comparable storefront system by one of the following:
- C. Aluminum:
 1. Alloy and temper recommended by manufacturer for type of use and finish indicated:
 - a. Sheet and plate: ASTM B209/B209M.
 - b. Extruded bars, rods, profiles, and tubes: ASTM B221/ASTM B221M.
 - c. Extruded structural pipe and tubes: ASTM B429/B429M.
- D. Framing Members:
 1. Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads:
 - a. Construction: Non-Thermal or Thermal, as indicated on Drawings.
 - b. Glazing system: Retained mechanically with gaskets on four sides.
 - c. Glazing Plane: Front.
- E. Accessories:
 1. Brackets and reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
 2. Fasteners and accessories:
 - a. Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials:
 - 1) Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2) Reinforce members as required to receive fastener threads.
 3. Concrete and masonry inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
 4. Concealed flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
 5. Framing system gaskets and sealants: Recommended by manufacturer for joint type.
- F. Glazing:
 1. Refer to Section 08 80 00 - Glazing for impact resistant laminated insulating glazing units
 2. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 3. Spacers and Setting Blocks: Elastomeric type.

- G. Entrance Doors:
 - 1. Refer to Section 08 13 16 - Aluminum Doors.
- H. Accessories:
 - 1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
 - 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) 30 mil (0.762 mm) thickness per coat.

2.4 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members:
 - 1. Fabricate components that, when assembled, have specified characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - d. Physical and thermal isolation of glazing from framing members.
 - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - f. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - h. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using screw spline system.
- E. Entrance Door Frames:
 - 1. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware:
 - a. At exterior doors, provide weather stripping at fixed stops.
 - b. At interior doors, provide weather stripping at stops to prevent metal to metal contact.
- F. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.5 ALUMINUM FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on shop drawings.

3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.3 INSTALLATION

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work:
 - 1. Do not install damaged components.
 - 2. Fit joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 5. Seal joints watertight unless otherwise indicated.
 - 6. Min anchorage #8 with 2 inch minimum embedment; minimum 2 inches from edges. Refer to shop drawings.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing specified in Section 08 80 00 - Glazing.
- G. Entrance Doors and Hardware:
 - 1. Install doors to produce smooth operation and tight fit at contact points:
 - a. Exterior doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - b. Field installed entrance door hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.4 TOLERANCES

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
 - 1. Location and plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.5 FIELD QUALITY CONTROL

- A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.
- B. Refer to Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

- C. Refer to Section 01 40 00 - Quality Requirements for general testing and inspection requirements.
- D. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- E. Provide field testing of installed curtain wall system by AAMA accredited independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Timing of Testing:
 - a. Test curtain wall prior to installation of exterior cladding.
 - 2. Preparation for Testing:
 - a. Ensure that flashings are installed and not damaged. Repair or replace any that have been damaged.
 - b. Verify that sealants are installed and fully cured.
 - 3. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 4. Conduct tests in each area prior to 10 percent, 50 percent, and 75 percent completion of this work.
 - 5. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 6.24 psf (299 Pa).
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
 - 6. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf (75 Pa).
 - a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft (0.5 L/s sq m).
- F. Failure of Testing:
 - 1. Repair or replace curtain wall components that have failed designated field testing.
 - 2. Retest failed curtain wall plus one additional to verify performance complies with specified requirements.

3.6 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer:
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3 second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 43 13

SECTION 08 63 00 - METAL-FRAMED SKYLIGHTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aluminum skylight framing system.
 - 2. Skylight glazing.
 - 3. Fasteners, anchors, reinforcement, and flashings.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Fabricated steel attachment devices.
 - 2. Section 06 10 00 - Rough Carpentry: Wood support curbs.
 - 3. Section 07 92 00 - Joint Sealants: Sealing joints between skylight frames and adjacent construction.
 - 4. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

- A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- K. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2023.
- L. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- M. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

- N. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- O. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2019 (Reapproved 2024).
- P. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
- Q. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications; 2018 (Reapproved 2023).
- R. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2023.
- S. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2018).
- T. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- U. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- V. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- W. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.
- X. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturer's specifications, standard details, and installation requirements.
- C. Shop Drawings: Indicate framed opening requirements and tolerances, spacing of members, anticipated deflection under load, affected related work, expansion and contraction joint locations and details, and sizes and locations for field welding.
 - 1. Show field measurements on shop drawings.
- D. Selection Samples: Full range of aluminum finish samples for Architect's color selection.
- E. Samples: Two samples, not less than 12 by 12 inches (305 by 305 mm) in size illustrating appearance of prefinished aluminum and specified glazing system, including glazed edge and corner.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- G. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.
- H. Structural Glazing Adhesive: Product data and calculations showing compliance with performance requirements.
- I. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- J. Manufacturer's Installation Instructions: Indicate special procedures, safety precautions, _____ and perimeter conditions requiring special attention.
- K. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

- L. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- M. Installer's qualification statement.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design skylight system under direct supervision of a professional engineer experienced in design of system type specified and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not fewer than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work specified in this section with at least three years of documented experience.
- D. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, shelf-life, storage conditions, and color.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide wrapping to protect prefinished aluminum surfaces. Do not use adhesive papers or spray coatings that bond when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work, including leaks, discoloration, failure of seal at insulated glazing units, and excessive thermal or structural movement, within a five year period after Date of Substantial Completion.
- C. Manufacturer Warranty: Provide five-year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Metal-Framed Skylights Manufacturers:
 - a. Artistic Skylight Domes Limited: www.artisticskylight.com.
 - b. DÄLYTE, an AiA Industries Company: www.dalyteusa.com.
 - c. Kalwall Corporation: www.kalwall.com.
 - d. Kingspan Light + Air, LLC; formerly Bristolite Daylighting Systems, Inc: www.bristolite.com.
 - e. Oldcastle Building Envelope: www.obe.com.
 - f. Solar Innovations, Inc: www.solarinnovations.com.
 - g. Super Sky Products Enterprises, LLC: www.supersky.com.
 - h. Unicel Architectural Corp: www.unicelarchitectural.com.
 - i. Velux America, Inc.: www.veluxusa.com.
 - j. Wasco Skylights - Part of the VELUX Group: www.wascoskylights.com.
 - 2. Structural Sealant Glazing (SSG) Adhesive:
 - a. Dow Corning Construction: www.dowcorning.com/construction.

- b. Momentive Performance Materials, Inc, exclusive licensee of General Electric:
www.siliconeforbuilding.com.
 - c. Tremco Inc: www.tremcosealants.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 METAL-FRAMED SKYLIGHTS

- A. Basis of Design Product:
- B. Metal Framed Skylights: Factory-fabricated, and glazed.
 - 1. Frame: Extruded aluminum structural members with integral condensation collection and guttering system thermally separated from exterior pressure bar.
 - 2. Glazing System: Pressure glazing bar system for sloped joints and two (2)-sided structural sealant glazing (SSG) for horizontal joints.
 - 3. Glazing: Insulating glass.
 - 4. Aluminum Finish: High performance organic coatings.
 - 5. Fabricate to prevent vibration harmonics, thermal movement transmitted to other building elements, and loosening, weakening, or fracturing of attachments or components of system.

2.3 PERFORMANCE REQUIREMENTS

- A. Provide metal-framed skylights that comply with the following:
 - 1. Structural Design: Design and size components to withstand dead loads and specified live loads without damage or permanent set.
 - 2. Wind Loads: Test in accordance with ASTM E330/E330M, using loads 1.5 times the specified design pressures and 10 second duration of maximum load.
 - 3. Concentrated Load: Design to withstand 250 pounds (114 kg) concentrated load at any location on framing members without permanent set.
 - 4. Glazing Support Member Deflection Under Wind Load: 1/180 of span, maximum.
 - 5. Structural Glazing Adhesive: Design system to limit stress on structural glazing adhesive to 20 percent of tested tensile adhesion and maximum compression or elongation to 25 percent of neutral dimension.
 - 6. Thermal Movement: Design system to accommodate thermal expansion and contraction over ambient temperature range of 100 degrees F (55 degrees C), dynamic loading and release of loads, creep of concrete structural members, and deflection of structural support framing without damage to skylight system components or loss of weathertightness.
 - 7. Energy Code Compliance: Comply with ICC (IBC), ASHRAE Std 90.1 I-P, or the authorities having jurisdiction as required for metal-framed skylights.
 - 8. Thermal Resistance of Skylight Framing System: R-value (RSI-value) of ____ deg F hr sq ft/Btu (____ K sq m/W).
 - 9. Thermal Resistance of Light Transmitting Areas: R-value (RSI-value) of ____ deg F hr sq ft/Btu (____ K sq m/W).
 - 10. Air Leakage: 0.30 cfm/sq ft (1.50 L/sec sq m) maximum leakage when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E283/E283M.
 - 11. Structural Sealant Glazing (SSG) System: For individual glass lites, design framing members to not exceed a deflection normal to the wall of L/175 between supports with 3/4 inch (19 mm) maximum, and a deflection parallel to the wall of L/360 with 1/8 inch (3.2 mm) maximum, whichever is less.
 - 12. Water Penetration: None, when measured in accordance with ASTM E331 at a test pressure difference of 2.86 pounds per square foot (140 Pa).

2.4 MATERIALS

- A. Aluminum Extrusions: Alloy and temper 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B221 (ASTM B221M), with minimum thickness 1/8 inch (3.2 mm) for structural members and 1/16 inch (1.6 mm) for non-structural members.
- B. Formed Aluminum: Sheet material of alloy 5052, 5005, or 6061-T651 members complying with ASTM B209/B209M, with minimum thickness 1/8 inch (3.2 mm) for structural members and 1/16 inch (1.6 mm) for non-structural members.
- C. Internal Reinforcement: ASTM A36/A36M Steel shapes as required for strength and mullion size limitations, hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
- D. Insulating Glass: Sealed insulated units, outer pane of clear transparent, laminated glass; inner pane of clear transparent, wired glass; space of sealed air, metal edge frame.
- E. Glazing Accessories: As recommended by manufacturer of skylight system.
- F. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
 - 1. SSG adhesive in compliance with ASTM C920; Type M - Multicomponent, Grade NS, Class 50, Use NT, G, and A.
 - 2. Ultimate Tensile Strength: Minimum of 50 psi (345 kPa) as determined by test method ASTM C1135 under the following conditions.
 - a. Exposure to air temperatures of 190 degrees F (88 degrees C) and minus 20 degrees F (minus 29 degrees C).
 - b. Water Immersion for seven (7) days, minimum.
 - c. Exposure to weathering for 5,000 hours, minimum.
 - 3. Sealant Design Tensile Strength: 20 psi (139 kPa), maximum.
 - 4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
 - 5. Shelf Life: Six (6) months, minimum.
 - 6. Color: Black.
 - 7. Volatile Organic Compound (VOC) Content: Less than 2.67 ounces per gallon (20 g/L).
 - 8. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
 - 9. Acceptable Products:
 - a. Products manufactured by Dow Corning Construction.
 - b. Products manufactured by Momentive Performance Materials, Inc.
 - c. Products manufactured by Tremco Inc.
- G. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
- H. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type.
- I. Protective Back Coating: Asphaltic mastic, ASTM D4479/D4479M Type I.
- J. Fasteners: Stainless steel.
- K. Flashing: Matching finish of skylight frame system components; secure using un-concealed fastening method, and seal with weather-tight sealant.
 - 1. Galvanized steel, 26 gauge, 0.0179 inch (0.45 mm) minimum base metal thickness.
- L. Anchorage Devices: Type recommended by manufacturer, exposed to view.

2.5 FABRICATION

- A. Rigidly fit and secure joints and corners with screw and spline; fabricate rigid joints with connections that are flush, hairline, and weatherproof.

- B. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.
- C. Drain to exterior any water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system.
- D. Prepare components to receive concealed anchorage devices, and ensure that fasteners will be concealed upon completion of installation.
- E. Adhere glass to glazing frames with structural adhesive and cure under controlled conditions in shop. Field glazing of frames to glass is not acceptable.

2.6 FINISHES

- A. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system; interior surfaces only.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that structural curb is ready to receive skylight system. Coordinate installation of roofing and other adjacent work to ensure weathertight construction.

3.2 PREPARATION

- A. Apply single coat of protective coating to concealed aluminum and steel surfaces in contact with dissimilar materials.

3.3 INSTALLATION

- A. Install metal-framed skylights in accordance with manufacturer's instructions and ASTM E2112.
- B. Set skylight structure plumb, level, and true to line, without warp or rack of frames or glazing panels. Anchor securely in place in accordance with approved shop drawings.
- C. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Install base flashings in accordance with Section 07 62 00 - Roof Related Sheet Metal.
- E. Pack fibrous insulation in shim spaces at perimeter of assembly to ensure continuity of thermal barrier.
- F. Install glazing in accordance with Section 08 80 00 - Glazing.
- G. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weather-tight sealant in accordance with manufacturer's instructions.
- H. Touch up damaged finishes so repair is imperceptible from 6 feet (1.8 m) distance, and remove and replace components that cannot be acceptably touched up.

3.4 TOLERANCES

- A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet (1 mm per 1 m), or 3/8 inch (9.5 mm) total in overall dimension.
- B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inches (1.6 mm).

3.5 FIELD QUALITY CONTROL

- A. Provide services of metal-framed skylight manufacturer's field representative to observe for proper installation of system and submit report.
- B. Refer to Section 01 40 00 - Quality Requirements for general testing and inspection requirements.
- C. Water-Spray Test: Provide water spray quality test of installed metal-framed skylight components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.

- D. Repair or replace metal-framed skylight components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.6 CLEANING

- A. Upon completion of installation, thoroughly clean skylight aluminum surfaces in accordance with AAMA 609 & 610.
- B. Remove protective material from prefinished aluminum surfaces.
- C. Wash down exposed surfaces; wipe surfaces clean.
- D. Remove excess sealant by methods recommended by skylight manufacturer.

END OF SECTION 08 63 00

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SECTION 08 71 00

FINISH HARDWARE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing and installing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the finish hardware suppliers bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the hardware supplier's base bid. The hardware supplier shall coordinate with all affected suppliers as required to insure a functional card access system.
- B. The Hardware Supplier shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the hardware supplier to address any such issue shall be considered acceptance of the hardware specified and all discrepancies shall be corrected at the hardware supplier's expense and considered a part of their base bid. Change orders shall not be issued if deemed by the Architect and/or Alamo College District to fall under and/or be covered as a part of the supplier's base bid, due to failure to comply with this instruction notification.
- C. Items include but are not limited to the following:
 - 1. Hinges & Continuous Hinges
 - 2. Flush Bolts
 - 3. Exit Devices
 - 4. Locksets and Cylinders
 - 5. Push Plates – Pulls
 - 6. Coordinators
 - 7. Closers
 - 8. Kick, Mop and Protection Plates
 - 9. Stops, Wall Bumpers, Overhead Controls
 - 10. Electrified Hold Open Devices
 - 11. Thresholds, Seals and Door Bottoms
 - 12. Silencers
 - 13. Miscellaneous Trim and Accessories
 - 14. Wiring Diagrams
 - 15. Installation of all Finish Hardware

1.02 RELATED DOCUMENTS

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

1.03 RELATED WORK

Specified elsewhere that should be examined for its effect upon this section:

- A. Section 06 20 00 – Finish Carpentry
- B. Section 08 12 14 – Standard Steel Frames.
- C. Section 08 13 14 – Standard Steel Doors.
- D. Section 08 14 16 – Flush Wood Doors.
- E. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.
- F. Division 28 – Card Access Control
- G. Division 26 – Electrical

1.04 REFERENCES SPECIFIED

In this section subject to compliance as directed:

- A. NFPA-80 - Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2021 - International Building Code
- L. BHMA – Builder's Hardware Manufacturer's Association
- M. DHI – Door and Hardware Institute
- N. NFPA-70 – National Electrical Code

1.05 SUBMITTALS

- A. Hardware Schedules:
 - 1. Submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to these specifications as required.
- D. Submit any samples necessary as required by the Architect.

- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Electronic Security Hardware: Coordinate installation of the electronic security with the Architect and provide installation and technical data to the Architect and other related sub-contractor(s). Upon completion of the electronic security hardware installation, verify that all components are working properly and state in the required guarantee that this inspection has been performed.
- G. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware, except openings where only magnetic hold-opens are specified. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to owner at time of job completion.
- H. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an A.H.C. or person of equivalent experience who will be made available at reasonable times to consult with the Architect/Contractor and/or Owner regarding any matters affecting the finish hardware on this project.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGE

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a Two- (2) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

- 1. All Closers to have a thirty- (30) year written warranty.
- 2. All Exit Devices to have a ten- (10) year written warranty.
- 3. All Grade 1 Locksets to have a ten- (10) year written warranty.

4. All Continuous Hinges to have a life of installation written warranty.

PART 2 PRODUCTS

2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of all fastenings shall harmonize with the hardware as to material and finish.
- D. All hardware shall be installed with the Manufacturers standard screws as provided. Use of any other type of fasteners shall not be permitted.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

Hardware shipped to the project job site shall be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Select, Hager, Ives or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, ball-bearing, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Reference 3.02 Hardware Sets).
- C. Exterior Door Hinges
 1. Provide out-swinging door hinges of solid bronze, steel, aluminum or stainless steel with non-removable pins or security studs as called for in this specification (Reference 3.02 hardware sets).
- D. Interior Door Hinges
 1. Stainless steel or steel polished and/or plated to match specified finish shall be provided. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof unless otherwise specified in 3.02 Hardware Sets.
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide (1 1/2 pairs). Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 4 1/2" x 4 1/2" (2 pair) unless otherwise specified in 3.02 Hardware Sets.

- F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width.
- H. At labeled door's steel or stainless steel, ball-bearing-type hinges shall be provided. For all doors equipped with closers provide ball-bearing-type hinges.
- I. Finishes
 - 1. At wood doors, hinges are to be plated to match adjacent hardware or as called for in 3.02 Hardware Sets.
 - 2. At hollow metal doors, hinges are to be aluminum or stainless steel at exterior out-swinging doors, unless otherwise specified in 3.02 Hardware Sets.
- J. Continuous hinges shall be as specified.

2.04 LOCK AND LOCK TRIM

- A. All locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locks, passage, and privacy sets shall be the product of Schlage Lock Co., "ND" Vandalgard series with Rhode's lever (No Substitutions). All locks, passage and privacy sets are to be provided in a dull chrome (626) finish. All locks and cylinders shall be prepared for large format Schlage interchangeable cores in the key section required by Alamo College District. Verify the key section with the Alamo College District locksmith prior to fabrication or ordering.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors. All pairs of doors shall have a 3/4" latch projection.
- C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 4000 as specified in 3.02 Hardware Sets.
 - 1. Hand of lock is to be easily reversible in the field or non-handed.
 - 2. All lever trim is to be through-bolted through the door.
 - 3. All pairs of doors shall be provided with a 3/4" latch throw or projection.
 - 4. All locks shall have the ability to be field repaired and lock function changed without the purchase of a new locking device.

2.05 PERMANENT CYLINDERS, KEYING AND ACCEPTABLE SUPPLIERS

- A. The hardware supplier shall provide locks and Exit devices requiring cylinders prepared for Schlage large format interchangeable core 6 pin key System and comply with performance requirements of ANSI A156.5. All keys shall be manufactured of nickel silver material only. All exterior and interior locks shall be supplied with keyed construction cores for the duration of the construction period by the hardware supplier. Construction cores are to be returned to the hardware supplier no later than thirty (30) days after the installation of permanent cores. The hardware supplier shall provide ten- (10) construction keys and two- (2) construction control keys total (No Substitutions Allowed).
- B. All permanent cores shall be keyed to the existing Master Key System as instructed by the Alamo College Representative at an onsite keying meeting coordinated by the general contractor. Provide and deliver all permanent cores and keys directly to the Alamo College

District (signature required for proof of delivery). The General Contractor and Alamo College District shall install all permanent cores and return all the construction cores to the general contractor (Verify Keyway required prior to fabrication with Alamo College District). Provide four (4) keys per permanent core and six (6) master keys per master set used. Stamp all keys, "Do Not Duplicate" and with key symbol as instructed by Alamo College District.

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets (#06/Rhodes).
- E. Exit Devices to be the modern push rail design. Finish shall be satin aluminum (628).
- F. All devices shall carry a ten - (10) year warranty against manufacturing defects and workmanship.
- G. Exit Devices shall be convertible in the field to accept electrified operations without purchasing completely new exit devices.
- H. Exit Devices shall be Von Duprin "33A & 99" series as specified (No Substitution).

2.07 SURFACE-MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle. All closers shall have been tested and passed a ten million-cycle test.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 through 4 or 6 as specified and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.
- E. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer.

- F. Closer to have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
 - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.
 - 2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening.
- I. Finish: Sprayed enamel finish shall match other hardware.
- J. Closers shall be LCN 4040XP as specified (**No Substitutions**).

2.08 AUTOMATIC DOOR OPENERS

- A. All automatic door openers shall be LCN 9500 Series as shown below:
 - 1. LCN #9531 STD - Single (Pull Side Mount)
 - 2. LCN #9542 REG - Single (Push Side Mount)
 - 3. LCN #9553 REG2 - Double (Push Side Mount) simultaneous
 - 4. LCN #9553 STD2 - Double (Pull Side Mount) simultaneous
- B. Provide two (2) each Hard-Wired Actuators & Mounting Boxes (8310-853T x 8310-867F or 8310 867S) 4.5" diameter engraved with handicapped logo & push-to-open for each Automatic Operator listed in 3.2 Hardware Sets. Provide Weather Ring 8310-801 for all exterior mounted Actuator's. Provide key operated "On/Off" switches #8310-806K at all Automatic operators. Provide Mullion Mounted Actuator if required and requested in lieu of the 8310-853T listed above.

2.09 DOOR STOPS AND HOLDERS

- A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors. The contractor shall place wood blocking in all stud walls specified and scheduled to receive wall stops.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified.
- D. Finish: Same as other hardware where available.
- E. Acceptable Products
 - 1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.

2.10 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pulls, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.
- B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16 gauge (.050 inches) thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.
- C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- D. Finish: Same as other hardware where available.

2.11 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Rockwood and Trimco are acceptable. Finish shall match adjacent hardware.
- B. Provide and install only at locations approved by code.

2.12 THRESHOLDS AND SEALS

- A. Provide materials and finishes as listed in hardware sets and manufactured by Zero. Equivalent product by National Guard Products and Pemko are acceptable if proven to be equal to products specified. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with stainless steel sleeve anchors #226 and full body strength fill "V3" without exception. Supply all necessary anchoring devices for weather strip and sound seal.
- C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather stripping shall be provided with silicone inserts as specified in 3.02 Hardware Sets.
- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.

2.13 KEYED REMOVABLE MULLIONS

- A. Keyed removable mullions shall be Von Duprin KR4954 & KR9954 type with FSIC mortise cylinders. Finish shall be sprayed aluminum (SP28). Provide one (1) Mullion Storage Bracket MT54 and 154 Stabilizers with every mullion supplied (No Substitutions).

2.14 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.15 DOOR SILENCERS AND KEY CABINET

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three (3) or four- (4) each for each single door (coordinate with the frame manufacturer).
- B. Provide a Lund key cabinet #1200 for installation by the contractor as instructed by the Architect and ACD. Key cabinet shall be of such size as to hold 100% of the total number of keys supplied, plus 100% expansion. If requested by ACD the hardware supplier shall (On the Project Site) assist and train the owner's staff in the proper use of the key cabinet. This shall include the tagging of all keys, instructing the ACD staff as to the proper use of the key cabinet and how they can best maintain the key system. The hardware supplier shall send the Architect written confirmation that this has been completed. Confirmation shall include the date training occurred and names of all staff members trained.

2.16 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and Alamo College District.
- C. Architect and Alamo College District reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 EXECUTION OF AND/OR INSTALLATION

3.01 INSTALLATION OF FINISH HARDWARE

- A. All finish hardware shall be installed by the finish hardware supplier with at least ten (10) years of experience after a pre-installation meeting between the contractor, electrical contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware supplier/installer shall be responsible for the proper installation and function of all doors and hardware. Installation shall include wiring all electrified products (Including the required wire) to the power supply and/or junction box.
- B. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- C. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- D. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

139191 OPT0451367 Version 2

Hardware Group No. 003

For use on Door #(s):

XE100B	XE101	XE103	XE105	XE109.1	XE109
XE110	XE111	XE112	XE114	XE115	XE117
XE118	XE119	XE122.1	XE122	XE127	XE128
XE130	XE131	XE132	XE132	XE134	XE138
XE140	XE141	XE141A.1	XE141A	XE142A.1	XE142A
XE143B	XE144	XE145	XE146A.1	XE146A	XE147B
XE149	XE150.1	XE150	XEC7	XEC8	XS102
XS102A	XS104.1	XS104	XS105	XS108	XS109
XS110	XS111	XS112	XS114	XS115	XS125
XS127	XS128	XS129	XS131	XS131A	XS131B
XS131D	XS131E	XS133	XS134		

Provide each SGL door(s) with the following:

QTY	DESCRIPTION NOTE	CATALOG NUMBER EXISTING HARDWARE TO REMAIN	FINISH	MFR

Hardware Group No. 004

For use on Door #(s):

S113C	S113D	S118	S119	S121	S122

Provide each SL door(s) with the following:

QTY	DESCRIPTION ALL HARDWARE	CATALOG NUMBER PROVIDED BY SLIDING DOOR MFG	FINISH	MFR

Hardware Group No. 203T

For use on Door #(s):

E113A.3

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA VANDL STOREROOM LOCK	ND96TD RHO	626	SCH
1	EA FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA WALL STOP	WS406/407CCV	630	IVE
3	EA SILENCER	SR64	GRY	IVE

Hardware Group No. 403AT

For use on Door #(s):

S103B S103C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		

Hardware Group No. 403T

For use on Door #(s):

S113A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 501T

For use on Door #(s):

S103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	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 Group No. 800AV

For use on Door #(s):
S101

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
2	EA	DUMMY PUSH BAR	330 LENGTH AS REQ	626	VON
2	EA	DOOR PULL	VR910 DT	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MANUFACTURER		

Hardware Group No. C200T

For use on Door #(s):

E113	E113A.2	E113A	E120	E126	E129.1
E129.3	E129	E135	S107	S113	S116
S117	S123	S123A.1	S123A.2	S126	S130
S130A	XE148				

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
7	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	COORDINATOR	3780	689	ABH
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
			RHR LEAF ONLY		
2	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
			ALUM FRAME ONLY		
1	EA	STRIKE ASTRAGAL	43SP-DOOR HEIGHT	SP	ZER
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201CT

For use on Door #(s):
E146

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201T

For use on Door #(s):

E100A	E102	E104	E107	E123	E125
E136	E137	E139	E142	E143	E147
S103	S106	S107A	S113B	S120	XE116
XS124					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	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 Group No. C205

For use on Door #(s):
XE151

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	VANDL EU STOREROOM	ND96TDEU RHO RX CON 12V/24V DC	626	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA (2PCS JAMB HEIGHT)	AA	ZER
1	EA	GASKETING	429AA (1PC HEADER WIDTH)	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
1	EA	MULTITECH READER	MT15 (PROVIDED BY DIV 28)	BLK	SCE

Hardware Group No. C714AM

For use on Door #(s):

E113A.1 E129.2 S100 XE124 XSC5

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954B-STAB-MT54 8'6"	SP28	VON
2	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO 24 VDC	628	VON
4	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
4		CYLINDER	AS REQUIRED	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
1	EA	MULTITECH READER	MT15 (PROVIDED BY DIV 28)	BLK	SCE

Hardware Group No. C715A

For use on Door #(s):

S107.1	S126.1E	S130A.1	XE4	XE5	XE107.1
XE120.1	XE126.1	XE136.1	XE142.1	XE143.1	XE147.1
XS113C					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO 24 VDC	628	VON
2	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
2		CYLINDER	AS REQUIRED	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER BY DR MFG DR 131.2		
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
1	EA	MULTITECH READER	MT15 (PROVIDED BY DIV 28)	BLK	SCE

END OF SECTION

SECTION 08 71 13 - POWER DOOR OPERATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Operators for swinging doors.
 - 2. Operators for sliding doors.
 - 3. Controllers, actuators, and safety devices.
 - 4. Maintenance.
- B. Related Sections:

1.3 DEFINITIONS

- A. Activation Device: Device that sends an electrical signal to door operator to open door when actuated.
- B. Knowing Act: Consciously initiating the opening of a power-operated door using acceptable methods, including wall-mounted switches such as push plates and controlled access devices such as keypads, card readers, and key switches.

1.4 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. BHMA A156.10 - Power Operated Pedestrian Doors; 2024.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate power door operators with balance of door hardware and electrical work required for each affected door opening.
 - 1. Templates: Check other sections' shop drawings to confirm that adequate provisions are in place for locating and installing power door operators.
 - 2. Electrical System Roughing-in: Coordinate layout and installation of power door operators with connections to power supplies, remote activation devices, and electric door latching hardware.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following parties.
 - 1. Architect.
 - 2. Installer's Architectural Hardware Consultant (AHC).

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Samples: Two samples of exposed to view hardware and attachment hardware.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Maintenance contract.
- I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- J. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.
- K. Specimen warranty.
- L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Wrenches and other tools required for maintenance of equipment.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience, and a member of AAADM.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for components of power door operators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Operators for Swinging Doors:
 - a. ASSA ABLOY Entrance Solutions: www.besam-usa.com.
 - b. Detex Corporation: www.detex.com.
 - c. DORMA USA, Inc: www.dorma.com.
 - d. LCN, an Allegion brand: www.allegion.com/us.
 - e. Horton Automatics: www.hortondoors.com.
 - f. NABCO Entrances Inc: www.nabcoentrances.com.
 - g. Portalp USA: www.portalpusa.com.
 - h. Record-USA: www.recorddoors.com.

- i. Stanley Access Technologies: www.stanleyaccess.com.
- 2. Operators for Sliding Doors:
 - a. Stanley Access Technologies: www.stanleyaccess.com.
- 3. Operators for Folding Doors:
 - a. NABCO Entrances inc: www.nabcoentrances.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 POWER DOOR OPERATORS - GENERAL

- A. Electrically Operated or Controlled Hardware: Provide necessary power supplies, relays, and interfaces as required for proper operation; provide wiring between control components and to building power connection in compliance with NFPA 70.
- B. Comply with ADA Standards for egress requirements.
- C. Comply with NFPA 101 and requirements of authorities having jurisdiction; provide units selected for actual door weight and for light pedestrian traffic unless otherwise indicated.
- D. Exterior and Vestibule Doors: Provide equipment suitable for ambient operating temperature range of minus 20 to plus 140 degrees F (minus 29 to plus 60 degrees C).
- E. Exterior Doors: Provide units capable of operating, closing, and holding doors closed under positive and negative differential pressure; if necessary, provide power closing.
- F. System Integration: Integrate operator functionality with other systems as required for a complete working installation.

2.3 OPERATORS FOR SWINGING DOORS

- A. Door Operator, Type ____: Hydraulic.
 - 1. Applications: Include operators for single and double doors.
 - 2. Hydraulic Operators: ____ hp (____ W) minimum, self-contained, electrically driven.
 - 3. Speed Control: Variable, field-adjustable opening and closing cycles.
 - 4. Functionality: Full-power open, spring close operation.
 - a. Full-Power Operators: Comply with BHMA A156.10; safeties required.
 - 1) Comply with UL 325; acceptable evidence of compliance includes UL (DIR) or ITS (DIR) listing or test report by testing agency acceptable to authorities having jurisdiction.
 - 2) Force Required to Set Door in Motion When Unpowered: 30 lbf (133 N), maximum, measured at 1 inch (25.4 mm) from the latch edge of the door at any point in the closing cycle.
 - 3) Signage: Provide signage in accordance with BHMA A156.10.
 - 5. Mounting: Surface mounted overhead.
 - 6. Components:
 - a. Header Case: Manufacturer's standard extruded aluminum profile containing door operator and door mounting components.
 - b. Motor and Gearbox Assembly: Manufacturer's standard sealed motor, gearbox, and drive belt.
 - 7. Power Supply Units: Self-contained, electrically operated, and independent of door operator.
 - 8. Actuators: Manufacturer's standard.
 - a. Push-Side Actuator: Mat switch.
 - b. Pull-Side Actuator: Mat switch.
 - 9. Pull-Side Safety: Door mounted.

2.4 OPERATORS FOR SLIDING DOORS

- A. Door Operator, Type ____: Electromechanical .
 - 1. Applications: Include operators for single and biparting doors.
 - 2. Electromechanical Operators: ____ hp (____ W) minimum, self-contained, chain driven, with release clutch.
 - 3. Speed Control: Variable, field-adjustable opening and closing cycles.
 - 4. Functionality: Full-power open and close.
 - 5. Power Supply Units: Self-contained, electrically operated, and independent of door operator.
 - 6. Mounting: Surface mounted overhead.
 - 7. Components:
 - a. Header Case: Manufacturer's standard extruded aluminum profile containing door operator and door mounting components.
 - b. Motor and Gearbox Assembly: Manufacturer's standard sealed motor, gearbox, and drive belt.
 - c. Track: Manufacturer's standard extruded aluminum shape.
 - d. Carrier Assemblies: Manufacturer's standard, with vertical reinforcing member to prevent sagging when door leaf is swung under breakaway conditions.
 - 1) Rollers: Steel roller wheels with sealed bearings, with two support rollers and one anti-rise roller at each door leaf.
 - 8. Actuators:
 - a. Push-Side Actuator: Mat switch.
 - b. Pull-Side Actuator: Mat switch.
 - 9. Pull-Side Safety: Door-mounted.

2.5 CONTROLLERS, ACTUATORS, AND SAFETY DEVICES

- A. Controllers: Manufacturer's standard for products specified.
 - 1. Provide microprocessor operated controller for each door.
- B. Actuators: Manufacturer's standard for products specified and as specified below.
 - 1. Comply with BHMA A156.10 for actuator and safety types and zones.
 - 2. Mat Switch Actuator/Safety: Surface-mounted, hermetically sealed molded vinyl, ____ inch (____ mm) thick with two-plate contact sheet, low voltage operation.
 - 3. Proximity Detector Actuator/Safety: Microwave; distance of control sensitivity adjustable.
- C. Safety Devices: Manufacturer's standard units recommended for project applications and conditions.
 - 1. Comply with BHMA A156.10 for actuator and safety types and zones.
 - 2. Photo-Electric Actuator/Safety: Horizontal single ray device, with aluminum housing for light source and relay units.
 - 3. Swinging Door Safety Device: Door-mounted proximity detector device arranged to prevent operation of door when persons or obstructions are in the swing zone.

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
 - 1. Refer to Basis of Design product.
- B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- C. Disconnect Switch: Factory mount disconnect switch in control panel.

2.7 FINISHES

- A. Aluminum Finishes: Manufacturer's standard.

1. Class I Natural Anodized Finish: Clear anodic coating; AAMA 611 AA-M12C22A41, minimum dry film thickness (DFT) of 0.7 mil, 0.0007 inch (0.018 mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify installation conditions including, but not limited to the following: opening sizes, floor conditions, plumb and level mounting surfaces.
- B. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
- C. Verify that electric power is available, in the correct location, and of the correct characteristics.

3.2 INSTALLATION

- A. Coordinate installation of components with related and adjacent work.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.
- D. Provide for dimensional distortion of components during operation.
- E. Install pneumatic lines and door power units in a manner to prevent condensation or freezing.

3.3 ADJUSTING

- A. Adjust door equipment for correct function and smooth operation.

3.4 CLEANING

- A. Remove temporary protection, clean exposed surfaces.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstrate to Owner's Designated Representative (ODR) equipment operation, operating components, adjustment features, and lubrication requirements.

3.6 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to the Owner.

END OF SECTION 08 71 13

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SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Film Overlay (F).
 - 2. Insulating Glazing Units (GI).
 - 3. Tempered Glass (GT).
 - 4. Metal Infill Panes (MP).
 - 5. Glazing Sealants.
 - 6. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- C. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- D. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- G. ASTM C1281 - Standard Specification for Preformed Tape Sealants for Glazing Applications; 2016.
- H. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current.
- I. AAMA 800 - Specifications and Test Methods for Sealants; 2016.
- J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- K. ASTM C1651 - Standard Test Method for Measurement of Roll Wave Optical Distortion in Heat-Treated Flat Glass; 2025.
- L. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- N. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

- S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.4 DEFINITIONS

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.
B. Interspace: Space between lites of an insulating glass unit.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State in which the Project is located, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the BIBC and ASTM E1300.
1. Design Wind Pressures: As indicated on Structural Drawings.
 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Structural Drawings.
 - b. Basic Wind Speed: As indicated on Structural Drawings.
 - c. Importance Factor: As indicated on Structural Drawings.
 3. Exposure Category: As indicated on Structural Drawings.
 4. Design Snow Loads: As indicated on Structural Drawings.
 5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
 2. For laminated glass lites, properties are based on products of construction indicated.
 3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.6 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.

- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Designer's Qualification Statement.
- F. Product Certificates: Submit glass product certificates required by Code.
 - 1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- G. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
 - 1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
 - a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
 - 2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- H. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
 - 2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of the IBC for glazing.
 - 2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 16 CFR 1201 (Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials, published in the Code of Federal Regulations) and ANSI Z97.1.
 - b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
 - 3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
 - 4. Glazing Publications: Comply with published recommendations of glass product organizations
 - a. GANA: Glazing Manual.
 - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
 - c. GANA: Laminated Glazing Reference Manual.
 - d. AAMA: AAMA GD SG-1 Glass Design for Sloped Glazing.
 - e. AAMA: TIR A7 Sloped Glazing Guidelines.
 - f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.

- g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
 - 5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
 - 6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - a. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
 - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
 - 7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
 - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
 - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Fabricator Qualifications:
- D. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- E. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- F. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- G. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- H. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- I. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- J. Install glazing in mockups specified in to match glazing systems required for Project, including glazing methods.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- K. Pre-Construction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- L. Pre-Installation Conference: Conduct conference at site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.11 WARRANTY

- A. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.

- D. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Glass Film:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 FABRICATORS

- A. Manufacturer-certified fabricators.

2.3 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.4 MATERIALS

- A. Clear, Annealed, Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully-Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. Optical Distortion Limits: Maximum peak-to-valley wave 0.005 inch (0.127 mm) in the central area of the glazing lie, excluding the leading and trailing 12 inches (305 mm) per ASTM C1651.
 - 3. Maximum center-kink of 0.001 inch (0.025 mm) when roll wave is measured over the surface of the glass perpendicular to the direction of travel through the tempering furnace.
 - 4. Maximum localized bow (warp) per lite shall be 1/32 inch (0.79 mm) per linear foot, one-half of the ASTM C1048 allowance. Maximum overall bow (warp) per lite shall be one-half of the ASTM C1048 allowance.
- C. Glass Film Overlay: Translucent, dimensionally stable, cast PVC film, 2 mil (0.05 mm) minimum thickness, with pressure sensitive, clear adhesive back for adhering to glass and releasable protective backing.

2.5 INSULATING GLAZING UNITS

- A. Insulating Glazing Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
- B. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
 - 1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum
 - 2. Desiccant: Molecular sieve or silica gel, or a blend of both.
 - 3. Performance Properties: Refer to Glazing schedule.
- C. Spandrel Glass:
 - 1. Silicone Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.

2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C1048.

2.6 GLASS FILM

- A. Performance Requirements:
 1. Scratch resistant coating that, after fully cured, facilitates cleaning without damaging or scratching film.
 2. Optical Distortion: When viewed from a distance of 10 feet at angles up to 45 degrees from either side of the glass, there is no discernible distortion.
 3. Edges: Seal edges except when the film is applied with a lacquer that prevents moisture or free water from penetrating between the film and the glass.
- B. Coating: Provide coating with uniform finish, without noticeable pin holes, streaks, thin spots, scratches, or banding.
 1. Light Transmission:
 - a. Maximum Variation across Width and Length: Not to exceed 1 percent.
 - b. Variation in Transmission across Width and Length: Not to exceed 2 percent.
- C. Rate of Change of Total Transmission across Width and Length: Not to exceed 1 percent in 4 inches.

2.7 GLAZING ACCESSORIES

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- C. Colors of Exposed Glazing Sealants: As selected by the Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. Dow Corning Corporation.
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - f. Pecora Corporation.
 - g. Polymeric Systems, Inc.
 - h. Schnee-Morehead, Inc., an ITW company.
 - i. Sika Corporation.
- H. Glazing Sealants for Fire-Resistance-Rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 2. Colors of Exposed Glazing Sealants: As selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
 1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

2. Setting Blocks: Silicone, minimum 4 inches long and wide enough to fully support all lites of glazing unit.
3. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 2. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's recommendations.
 3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 0.06 inch (1.5 mm) at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (51 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.
- C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
 1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
 2. Wipe metal surfaces with isopropyl alcohol unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.
- E. Glass Film Preparation:
1. Remove particulate matter on the glass surface using a scraping blade.
 2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8 inch (3 mm) 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
 1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
 2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
 3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 4. Do not remove release paper from tape until right before each glazing unit is installed.
 5. Apply heel bead of elastomeric sealant.
 6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
 1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
 1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
 2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.

3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
 4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
 5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.
- O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying in pattern indicated on Drawings to the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.6 mm) 1/16 inch (1.5 mm) to 1/32 inch (0.79 mm) of the window sealing device. Avoid scoring glass when cutting film.
 2. Clean film and leave free of soap residue and squeegee marks.
- P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch (3 mm) in any story and 1/4 inch (6 mm) in any 45 feet (13.7 m) run.
 2. Maximum Deviation from Horizontal: 1/8 inch (3 mm) in any 30 feet (9 m) run.
 3. Maximum Deviation from True Alignment: 1/32 inch (0.79 mm) for any two (2) abutting units. Allow no edge projections.
 4. Maximum Joint Gap: 1/32 inch (0.79 mm).

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 SCHEDULE

4.1 GLAZING SCHEDULE

- A. Film Overlay (F):
1. F1: Privacy Film Overlay: Matte privacy film.
 - a. Basis of Design Product:
 - 1) LLumar Decorative Frost Film – Acid Etch manufactured by Eastman, a subsidiary of CPFilms, Inc.
- B. Insulating Glazing Units (GI):
1. General
 - a. Minimum Performance Requirements per ICC (IECC):
 - 1) U-Factor: 0.50 (maximum).
 - 2) Solar Heat Gain Coefficient: 0.25 (maximum).
 2. Type GI1:
 - a. Basis of Design: SolarBan 90 on Clear manufactured by Vitro.Architectural Glass.
 - b. Assembly:

- 1) Exterior Lite:
 - (a) Thickness: 1/4 inch (6 mm).
 - (b) Color: Clear.
 - (c) Coatings: Solarban 90 on surface #2.
- 2) Gap:
 - (a) Size: 1/2 inch (13 mm).
 - (b) Gas: Air.
- 3) Interior Lite:
 - (a) Thickness: 1/4 inch (6 mm).
 - (b) Color: Clear.
 - (c) Coatings: Solarban 90 on surface #3.
- c. Performance:
 - 1) Visible Transmittance (%): 51.
 - 2) Winter Night-time U-value: 0.29 (air).
 - 3) Solar Heat Gain Coefficient: 0.23.
 - 4) Light to Solar Gain Ratio (LSG): 2.22.
- C. Tempered Glazing (GT):
 1. Type GT1: 1/4 inch thick glazing quality, clear, tempered float glass.
- D. Metal-Faced Insulated Infill Panels (MP):
 1. Type MP1: 1 inch (25 mm) thick, metal-faced panel, color: As selected by Architect from manufacturer's full line.
 2. Type MP2: 1 inch (25 mm) thick, metal-faced panel, color: As selected by Architect from manufacturer's full line.
 3. Type MP3: 1 inch (25 mm) thick, metal-faced panel, color: As selected by Architect from manufacturer's full line.

END OF SECTION 08 80 00

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SECTION 09 05 00 - COMMON WORK RESULTS FOR FINISHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Substrate testing.
 - 2. Waterproof membranes.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete design, underslab vapor barrier and finished concrete surface required to accept flooring adhesive and finish flooring system.
 - 2. Section 03 54 00 - Cast Underlayment: Leveling of existing concrete slabs.
 - 3. Section 05 75 00 - Decorative Formed Metal: Extruded metal transitions and trim.
 - 4. Section 06 10 00 - Rough Carpentry: Wood-based panel underlayment required to accept installation of finish flooring systems.
 - 5. Section 06 16 00 - Sheathing: For proper wood-based panel underlayment required to accept installation of finish flooring systems.
 - 6. Section 09 05 61 - Common Work Results for Flooring Preparation.
 - 7. Section 09 65 00 - Resilient Flooring.
 - 8. Section 09 65 13 - Resilient Base and Accessories.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007 - Not Active.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- G. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- H. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- K. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.
- L. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Adhesives.
 - 2. Leadership in Energy and Environmental Design (LEED).
 - 3. Volatile Organic Compound (VOC).

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's printed descriptions of materials, components, and systems; performance criteria; use limitations; preparation instructions and recommendations; storage and handling requirements and recommendations; and installation methods.
- B. Certificates:
 - 1. Submit with manufacturer's signature certifying that each product and/or system meets the requirements of the performance characteristics, physical criteria, and applicable standards specified.
 - a. Provide Master Grade Certificate as specified in ANSI A137.1.
- C. Test and Evaluation Reports:
 - 1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each product and/or system, indicating physical, chemical, and performance characteristics.
- D. Samples:
 - 1. Submit samples showing full range of color and texture variations expected.
 - 2. Full size units of each type and composition of tile, and for each color and finish required.
 - 3. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (305 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 4. Waterproof membrane in 6 by 6 inches (150 by 150 mm) sample.
 - 5. Thresholds in 6 inch (150 mm) lengths.
- E. Closeout Submittals:
 - 1. Operation and Maintenance Data: Including, but not limited to, methods for maintaining installed products and precautions against cleaning materials with methods detrimental to finishes and performance.
 - 2. Executed Warranty Documentation: Manufacturers' material warranties and installers' workmanship warranty.
 - 3. Record Documents: Drawings, Specifications, Product Data.

1.6 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 03 54 00 - Cast Underlayment.
 - 3. Section 06 10 00 - Rough Carpentry: Sub-flooring.
 - 4. Section 09 65 00 - Resilient Flooring.
- B. Static Coefficient of Friction (SCOF): For tile installed on walkway surfaces which are not anticipated to be wet, provide products with values determined by testing identical products per ASTM C1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Ramp Surfaces: Minimum 0.8.
- C. Dynamic Coefficient of Friction (DCOF): Per ANSI A137.1 Section 9.6 DCOF AcuTest:
 - 1. Wet Level Surfaces: Minimum 0.42 unless noted otherwise.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Surface Burning Characteristics: ASTM E84; identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. Texas Accessibility Standards (TAS).
- B. Qualifications:
 - 1. Installer / Applicator: Perform installation with skilled, experienced, and trained workmen supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.
 - 2. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC 17025 or ASTM E329 and ASTM E699.
- C. Source Limitations:
 - 1. Obtain spray-applied adhesive through one source from a single manufacturer.
 - 2. Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - 3. Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
 - a. Obtain each of the following products, specified in related Sections, through one source from a single manufacturer for each product:
 - 1) Waterproofing.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects, and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage, and Handling per manufacturer's recommendations, Section 01 60 00 - Product Requirements, and as follows:
 - 1. Delivery and Acceptance Requirements:
 - a. Deliver materials to Project site in an undamaged condition, in original, unopened and undamaged packages or containers bearing manufacturer's intact label, names, brand names, types, and thicknesses of contents, and proper handling, storing, unpacking, protecting, and installation instructions, as warranted.
 - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
 - b. Inspect shipped materials on delivery to ensure compliance with requirements of Contract Documents and to ensure that products are undamaged and properly protected. Reject damaged goods and accept properly ordered, protected, and undamaged goods.
 - 2. Storage and Handling Requirements:
 - a. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

- b. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
 - c. Store adhesive materials in a dry, temperature-controlled interior area at 65 to 80 degrees F (18 to 27 degrees C). Protect materials from damage from improper handling, exposure to temperature extremes, and the action of other trades.
 - 3. Packaging Waste Management:
 - a. Request in writing that manufacturers, fabricators, suppliers, and shippers provide the least amount of packaging that adequately and properly protects, supports, and contains the items shipped, and is reusable, returnable, or recyclable.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacturer-approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F (10 degrees C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.10 EXTRA STOCK

- A. Refer to related sections for extra stock requirements.

1.11 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 - Project Management and Coordination.

1.12 WARRANTY

- A. Refer to related sections for specific product warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Spray-Applied Adhesives:
 - a. Spray-Lock; www.spray-lock.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Volatile Organic Compound Limits:
 - a. Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

2.3 MATERIALS

- A. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from

flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

- B. Spray-Applied Adhesive:
 - 1. Water-based pressure-sensitive aerosol adhesive, VOC-Free, non-flammable, and non-HAP, emitting no dangerous fumes or odors.
 - 2. Basis of Design Product(s):
 - a. Spray-Lock™ 6500 for adhering vinyl backed carpet tile and luxury vinyl tiles (LVT) or planks.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
- B. Ambient Conditions per manufacturer's written recommendations, and as follows:
 - 1. New concrete slabs shall be flat, clean, and dry meeting all moisture tests passing manufacturer's written requirements.
 - 2. Environmental Limitations: Maintain temperature and relative humidity per manufacturer's recommendations.
 - a. Maintain space, substrate temperatures, and RH for time prior to, during, and after installation as recommended.
 - 3. Acclimate floor finish materials into spaces they will be installed a minimum 48 hours in advance of installation.
 - a. Do not install until all floor finish materials are same temperature as space where they are to be installed.

3.2 EXAMINATION - GENERAL

- A. Contractor shall examine preparatory work by others, with Installer/Applicator present, for compliance with requirements affecting Work performance.
 - 1. Contractor shall notify Architect of any issues which would affect installation of finish. Absence of such notification shall constitute acceptance of responsibility by Contractor.
- B. Verify that field measurements, surfaces, substrates, structural support, tolerances, levelness, plumbness, temperature, humidity, moisture content level, cleanliness, and other conditions are as required by the manufacturer, and ready to receive Work.

3.3 EXAMINATION - FLOORING

- A. Verify that concrete floors to receive resilient flooring meet ASTM F710 requirements and are flat as recommended by floor finish manufacturer.
- B. Verify that wood and panel type underlayment substrates to receive resilient flooring meet ASTM F1482 requirements and are flat as recommended by floor finish manufacturer.
- C. Test substrates as required by manufacturer to verify proper conditions.
 - 1. Portland-Cement Concrete:
 - a. Perform moisture testing to verify that concrete substrate is sound and dry. Both of the following tests are required:
 - 1) Perform relative humidity (RH) test using in situ probes per ASTM F2170. Proceed with installation only after each substrate measures a maximum 75 percent RH.
 - 2) Perform anhydrous calcium chloride testing per ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 7 lbs of water/1000 sf (3.18 kg of water/92.9m²) in 24 hours.
 - b. Perform alkalinity testing to verify pH level is 11 or below per ASTM F710.
 - c. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.

2. Wood Underlayment: Shall be dry, clean, structurally sound, well nailed and/or glued, free of voids, and with joints that do not exceed 1/16 inch (1.6mm) per floor finish manufacturer's installation instructions.
3. Proceed with installation only after unsatisfactory conditions have been corrected.
 - a. Commencement of work related to this Section will constitute acceptance of conditions.

3.4 INSTALLATION - GENERAL

- A. Lay out tiling so that no tile is cut to less than 1/2 of its full size in either direction.
- B. Slope tile within 3 foot diameter of a floor drain, unless otherwise noted.
- C. Form internal angles square.

3.5 INSTALLATION - STONE THRESHOLDS

- A. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
 1. Inspect floor finish system installation for non-conforming Work including, but not limited to, the following:
 - a. Lack of adequate adhesion.
 - b. Adhesive overspray.
 - 1) Clean off water-based adhesive overspray with a damp cloth.
 - c. Improper substrate preparation as indicated by:
 - 1) Air blisters.
 - 2) Buckling.
 - 3) Cracks.

3.7 CLEANING

- A. Clean finishes as required and in accordance with manufacturer's recommendations.

3.8 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures.

END OF SECTION 09 05 00

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - a. Resilient tile.
 - 2. Preparation of existing concrete floor slabs for installation of floor coverings.
 - 3. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - a. The Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under The Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
 - 4. Remedial floor coatings.
 - 5. Remedial floor sheet membrane.
- B. Related Sections:
 - 1. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
 - 2. Section 01 74 19 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.
 - 3. Section 02 41 00 - Demolition: Removal of existing flooring.
 - 4. Section 03 54 00 - Cast Underlayment: Self-leveling underlayment applied as remediation treatment.
 - 5. Section 07 95 13 - Expansion Joint Cover Assemblies.
 - 6. Section 09 65 00 - Resilient Flooring.

1.3 REFERENCE STANDARDS

- A. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Adhesives.
 - 2. Volatile Organic Compound (VOC).

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.6 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.

1. Manufacturer's qualification statement.
 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 4. Manufacturer's installation instructions.
 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- C. Adhesive Bond and Compatibility Test Report.
- D. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician-Grade I certificate.

1.7 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
1. Section 03 54 00 - Cast Underlayment.
 2. Section 09 65 00 - Resilient Flooring.

1.8 QUALITY ASSURANCE

- A. The Contractor may perform adhesive and bond test with the Contractor's own personnel or hire a testing agency.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
 2. Testing Agencies:
 - a. Testing agencies acceptable to the Owner.
 - b. Substitutions: Submit to the Owner and the Architect.
- C. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification-Grade I.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.10 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

1.11 WARRANTY

- A. Provide Flooring Adhesive Manufacturer's:
1. Material and Workmanship Warranty:

- a. Aerosol (22oz, 18oz) Flooring Adhesive shall be free from defects in material and workmanship for a period of 2 years from date of manufacture when handled, stored and transported per adhesive manufacturer's requirements.
2. Delamination Warranty that there shall be no delamination failure:
 - a. Due to adhesive failure for a period of five (5) years from date of installation when applied to adhere approved flooring materials per Adhesive manufacturer's requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Remedial Floor Coatings:
 - a. Allied Construction Technologies, Inc: www.actechperforms.com.
 - b. ARDEX Engineered Cements: www.ardexamericas.com.
 - c. AVECS, LLC: www.avecs.build.
 - d. Crown Polymers, a division of American Polymers Corporation: www.crownpolymers.com.
 - e. Custom Building Products, a Quikrete Company: www.custombuildingproducts.com.
 - f. Floor Seal Technology, Inc: www.floorseal.com.
 - g. GCP Applied Technologies: www.gcpat.com.
 - h. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
 - i. LATICRETE International, Inc: www.laticrete.com.
 - j. Loba-Wakol, LLC: www.loba-wakol.com.
 - k. Maxxon Corporation: www.maxxon.com.
 - l. Polycoat Products; Polycoat PC FMB; www.polycoatusa.com.
 - m. Proflex Products, Inc: www.proflex.us.
 - n. Rust-Oleum Corporation: www.rustoleum.com.
 - o. Sika Corporation: www.sikafloorusa.com.
 - p. Stauf USA, LLC: www.staufusa.com.
 - q. Tnemec Company, Inc: www.tnemec.com.
 - r. USG Corporation: www.usg.com.
 - s. UZIN UTZ NORTH AMERICA, INC: us.uzin.com.
 2. Remedial Floor Sheet Membrane:
 - a. GCP Applied Technologies: www.gcpat.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

- A. Patching Compound: Refer to Section 03 54 00 - Cast Underlayment.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring

manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Basis of Design Product(s):
 - a. AC Tech 2170 manufactured by Allied Construction Technologies, Inc.
 - b. ARDEX MC RAPID manufactured by ARDEX Engineered Cements.
 - c. RE-ACT manufactured by AVECS, LLC.
 - d. CrownShield 8303 MVB manufactured by Crown Polymers.
 - e. TechMVC Moisture Vapor and Alkalinity Barrier manufactured by Custom Building Products.
 - f. MES 100 with Floor Seal FloorCem SLU manufactured by Floor Seal Technology, Inc.
 - g. Kovara AB 300 manufactured by GCP Applied Technologies.
 - h. TEC LiquiDam with TEC Level Set 200 SLU manufactured by H.B. Fuller Construction Products, Inc.
 - i. LATICRETE NXT Vapor Reduction Coating with LATICRETE NXT Level Plus manufactured by LATICRETE International, Inc.
 - j. LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment manufactured by LATICRETE International, Inc.
 - k. WAKOL PU 280 Moisture Barrier manufactured by Loba-Wakol, LLC.
 - l. Aquafin SG2 manufactured by Maxxon Corporation.
 - m. Polycoat PC FMB manufactured by Polycoat Products.
 - n. Moisture Barrier 25 with DPU - Deep Pour Underlayment manufactured by Proflex Products, Inc.
 - o. TVB - Topside Vapor Barrier 100% Solids manufactured by Rust-Oleum Corporation.
 - p. Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer manufactured by Sika Corporation.
 - q. ERP-270 Perma-Seal manufactured by Stauf USA, LLC.
 - r. Series 208 Epoxoprime MVT manufactured by Themec Company, Inc.
 - s. Durock Brand CST Moisture Vapor Reducer manufactured by USG Corporation.
 - t. UZIN PE 460 with UZIN PE 280 and UZIN NC 170 LevelStar manufactured by UZIN UTZ NORTH AMERICA, INC.
 2. Thickness: As required for application and in accordance with manufacturer's installation instructions, 1/8 inch (3.2 mm), maximum.
 3. Use product recommended by testing agency.
- C. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Basis of Design Product:
 - a. Kovara MBX manufactured by GCP Applied Technologies.
 2. Thickness: 28 mil (0.028 inch) (0.711 mm).
 3. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.1 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Refer to Section 02 41 00 - Demolition.

3.2 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:

- a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering in accordance with Section 02 41 00 - Demolition.
 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 3. Preliminary cleaning.
 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 7. Specified remediation, if required.
 8. Patching, smoothing, and leveling, as required.
 9. Other preparation specified.
 10. Adhesive bond and compatibility test.
 11. Protection.
- C. Remediations:
 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.3 WOOD SUBFLOORING PREPARATION

- A. Prepare Wood Substrates and Panel Type Underlayment per ASTM F1482 and floor finish manufacturer's requirements.

3.4 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.5 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.6 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.7 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.8 PREPARATION

- A. Refer to individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.9 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.10 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.11 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.12 APPLICATION OF SPRAY-APPLIED ADHESIVE

- A. Installation per each floor finish assembly product manufacturer's written instructions, and as follows:
 - 1. Spray-Applied Adhesive Method:
 - a. Do not place finish-flooring product until adhesive applied to substrate is ready to receive it per adhesive manufacturer's instructions.
 - b. Mark floor equivalent to manufacturer's recommended area for size of container used. Apply no more or less adhesive than what manufacturer recommends.
 - c. Outline perimeter of the room with a 4-5 inch (100-125 mm) wide band of adhesive. Apply the adhesive from 8-12 inches (200-300 mm) above the substrate.
 - d. Lay flooring finish material, adjust and reset until layout placement is certain.
 - e. Following installation of finish flooring (typically within an hour after installing) roll entire floor area with a 75 to 100 lb (34 to 45 kg) roller to ensure proper bonding with instant shear strength.
 - 2. Close space to traffic for 2 hours before beginning installation, however, flooring is immediately available after rolling for all range of use.

3.13 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 05 61

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum board.
 - 2. Partition framing systems.
 - 3. Exterior gypsum board for ceilings and soffits.
 - 4. Tile backing panels.
 - 5. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 05 40 00 - Cold Formed Metal Framing: Structural steel stud framing.
 - 3. Section 05 75 00 - Decorative Formed Metal: Decorative metal reveals and trim.
 - 4. Section 06 10 00 - Rough Carpentry: Building framing and blocking.
 - 5. Section 07 21 00 - Thermal Insulation: Thermal insulation.
 - 6. Section 07 27 26 - Fluid-Applied Air Barrier System: Vapor barriers.
 - 7. Section 07 84 13 - Penetration Firestopping.
 - 8. Section 07 92 00 - Joint Sealants: Acoustical joint sealant.
 - 9. Section 08 43 13 - Aluminum-Framed Storefronts.

1.3 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2024.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.
- K. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

- L. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- M. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- N. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.
- O. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.
- P. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- Q. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.
- R. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2024.
- S. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- T. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; 2009 Edition, March 1, 2009
- U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- V. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- W. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
 - 1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
 - 2. Ground Floor Lobbies: 1/120 at 15 psf.
 - 3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
 - 4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
 - 5. Typical Partitions: 1/240 at 5 psf.
 - 6. Other Partitions: 1/240 at 5 psf.
 - a. Maximum Deflection:
 - 1) L/240 at 5 lbf per sq. ft.
 - 2) L/120 at 5 lbf per sq. ft.
 - 3) L/120 at 7.5 lbf per sq. ft.
 - 4) L/120 at 10 lbf per sq. ft.
- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.5 SUBMITTALS

- A. Product Data: Submit for each type of drywall, including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.

- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.
- C. Samples:
 - 1. Trim Accessories: Full size sample in 12 inch (300 mm) long length for each trim accessory indicated.
 - 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with applicable requirements of building code for interior finishes.
- B. Single Source Responsibility:
 - 1. Framing Members: Obtain steel framing members from single manufacturer.
 - 2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
 - 3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
 - 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- D. Do not install panels that are wet, moisture damaged, and, mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

1. Steel Studs and Tracks:
 - a. CEMCO: www.cemcosteel.com.
 - b. ClarkDietrich: www.clarkdietrich.com.
 - c. Custom Stud, Inc.: www.customsteelcraft.com.
 - d. MBA Building Supplies: www.mbastuds.com.
 - e. MRI Steel Framing, LLC: www.mristeel framing.com.
 - f. Phillips Manufacturing Co.: www.phillipsmfg.com.
 - g. Steel Network, Inc. (The): www.steelnetwork.com.
 - h. Telling Industries: www.tellingindustries.com.
 2. Gypsum Board:
 - a. Certaineed Corporation: www.certainteed.com.
 - b. Georgia Pacific: www.gp.com.
 - c. National Gypsum Company: www.nationalgypsum.com.
 - d. USG Corporation: www.usg.com.
 3. Tile Backer Board:
 - a. USG Corporation: www.usg.com.
 4. Glass Mat Gypsum Sheathing Board:
 - a. USG Corporation: www.usg.com.
 5. Cementitious Board:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. National Gypsum Company: www.nationalgypsum.com.
 - c. USG Corporation: www.usg.com.
 6. Trim:
 - a. Fry Reglet Corporation: www.fryreglet.com.
 - b. Gordon, Inc.: www.gordon-inc.com.
 - c. Pittcon Industries: www.pittconindustries.com.
 - d. Schluter Systems: www.schluter.com.
 7. Extruded Partition Closure:
 - a. Gordon, Inc.: www.gordon-inc.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

- A. Framing Members: ASTM C754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
1. Steel Sheet Components: Comply with ASTM C645 requirements for metal.
 2. Protective Coating:
 - a. Standard: ASTM A653/A653M, G40, hot dip galvanized.
- B. Steel Framing Components: ASTM C754 for conditions indicated; hot dip galvanize complying with ASTM A653/A653M Z180.
1. Steel Studs and Runners: ASTM C645, 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.

2. Dimpled Steel Studs and Runners: ASTM C645, equivalent to minimum base metal thickness indicated on Drawings for depth indicated on Drawings.
 3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 4. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges; depth indicated on Drawings.
 5. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
 6. Hat Shaped, Rigid Furring Channels: ASTM C645; 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
 7. Cold Rolled Furring Channels 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
 - a. Depth: As indicated on Drawings.
 - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
 - c. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 8. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4 inch (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
 9. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 10. Slip Type Head Joints: Where indicated, provide one of the following:
 - a. Single Long Leg Runner System: ASTM C645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - b. Double Runner System: ASTM C645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
- C. Ceiling Suspension System:
1. Refer to Section 09 22 26.23 - Metal Suspension Systems.
- D. Gypsum Board: ASTM C1396/C1396M, applicable to type of gypsum board indicated and whichever is more stringent.
1. Wall Board:
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered and featured (rounded or beveled) for pre-filling.
 2. Ceiling Board: Manufactured for sag resistance
 - a. Type: X typical, C at fire-resistance-rated ceiling assemblies.
 - b. Thickness: 1/2 inch (12.7 mm).
 - c. Long Edges: Tapered.
 3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces.
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered.
- E. Impact Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Core and Thickness: 5/8 inch (15.9 mm), Type X.
 2. Surface Abrasion: ASTM C1629/C1629M, meet or exceed Level 1 requirements.

3. Indentation: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 4. Soft Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 5. Hard Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements according to test in Annex A1.
 6. Long Edges: Tapered.
 7. Mold Resistance: ASTM D3273, score of 10 as rated according to STM D3274.
- F. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C1178/C1178M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
1. Core and Thickness: 5/8 inch (15.9 mm) to match conditions, Type X.
 2. Long Edge: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- G. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325.
1. Thickness: 1/2 inch (12.7 mm) and 5/8 inch (15.9 mm) to match conditions.
 2. Long Edges: Standard.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 BEADS, JOINT ACCESSORIES, AND OTHER TRIM

- A. Exterior Trim: ASTM C1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
1. Shapes:
 - a. Cornerbead.
 - b. LC Bead: J shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
- B. Interior Trim: ASTM C1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
1. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC Bead: J shaped; exposed long flange receives joint compound.
 - d. L Bead: L shaped; exposed long flange receives joint compound.
 - e. U Bead: J shaped; exposed short flange does not receive joint compound.
 2. Flush Transition Molding:
 - a. Description: Metal trim for transition between gypsum board and suspended ceilings.
 - b. Basis of Design Product:
 - 1) 7904 manufactured by Armstrong World Industries, Inc.
 - c. Exposed Flange Size: 15/16 inch (24 mm).
 - d. Protective Film: Provide.
 - e. Color: White.
- C. Expansion (Control) Joint.
1. Basis of Design Products:
 - a. Products manufactured by Fry Reglet Corp.
 - b. Products manufactured by Gordon, Inc.
 - c. Products manufactured by Pittcon Industries.
- D. Decorative Metal Trims and Reveals: Refer to Section 05 75 00 - Decorative Formed Metal.
- E. Continuous Corner Bead: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer.
1. Basis of Design Products
 - a. Products manufactured by Fry Reglet Corporation.
 - b. Softforms SO-HSE-90 manufactured by Pittcon Industries.

- c. Products manufactured by Schluter Systems.
- F. Joint Treatment: ASTM C475/C475M.
 - 1. Joint Tape:
 - a. Exterior Gypsum Soffit Board: Paper.
 - b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
 - c. Joint Tape, Interior Gypsum Board: Paper.
 - 2. Joint Compound:
 - a. Gypsum Board: Pre-Filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
 - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
 - (a) Use setting type compound for installing paper faced metal trim accessories.
 - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
 - 3) Finish Coat: For third coat, use setting type, sandable topping compound.
 - 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
 - b. Cementitious Units: Recommended by backer unit manufacturer.
 - c. Tile Backing Panels: Recommended by backer unit manufacturer.
 - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
 - e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.
- G. Partition Closure Device:
 - 1. Description: Extruded aluminum partition closures are pre-assembled and spring-loaded to provide a tight fit for vertical junctures of partitions and window assemblies.
 - 2. Basis of Design Product:
 - a. Mullion Mate High STC manufactured by Gordon, Inc.
 - 3. Material: 6063-T5 temper, tensile strength 31 KSI (ASTM B221/ASTM B221M).
 - 4. Sound Transmission: STC 50 minimum.
 - 5. Width: As required.
 - 6. Accessories:
 - a. Partition end caps.
 - 7. Finish: Match adjacent storefront, window wall, or curtain wall system.
- H. Moisture Guard Trim:
 - 1. Description: ASTM C1047, rigid plastic, applied to bottom edge of gypsum board.
 - 2. Height: As indicated on Drawings.
 - 3. Depth: As required.
 - 4. Length: Greatest length available.
 - 5. Basis of Design Product:
- I. Auxiliary Materials: Comply with referenced installation standards and manufacturer's written recommendations.
 - 1. Steel Drill Screws: ASTM C1002, use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. Sound Attenuation Blankets: Refer to Section 09 81 00 - Acoustic Insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

- A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
- B. Gypsum Board Assemblies: Comply with requirements in ASTM C840 applicable to framing installation.
- C. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
 - 1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
 - 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two studs at each jamb, unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7 mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- D. Sound Insulation: Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- E. Gypsum Panels: Comply with ASTM C840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
 - 1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 - 2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
 - 3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite

- sides of partitions. Do not make joints other than control joints at corners of framed openings.
4. Form control and expansion joints with space between edges of adjoining gypsum panels.
 5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft (0.7 sq. m) in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.
 - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 to 3/8 inch (6.4 to 9.5 mm) wide joints to install sealant.
 6. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch (6.4 to 12.7 mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:
 - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 2. Multilayer Application:
 - a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- G. Backing Panels:
1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- H. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.
- I. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.

1. Control Joints: Install control joints according to ASTM C840 (30 feet (10 m) maximum), at each door and window jamb (unless noted otherwise), and in specific locations indicated on Drawings.
 2. Exterior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners.
 - b. LC Bead: Use at exposed panel edges.
 3. Interior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners.
 - c. LC Bead: Use at exposed panel edges.
 - d. L Bead: Use where indicated or necessary.
 - e. U Bead: Use at exposed panel edges.
- J. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - b. Level 2: Panels that are substrate for tile.
 - c. Level 3: Where indicated on Drawings.
 - d. Level 4: For surfaces receiving flat paints.
 - e. Level 5: For surfaces receiving gloss or semi-gloss paint, subjected to severe lighting, or receiving wall covering.
 4. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.
- K. Installation Tolerances:
1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
 2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- L. Fire-Resistance-Rated and Smoke Partitions Markings:
1. Each fire-resistance rated partition, smoke partition, or other wall requiring protected openings is to be marked as such as defined below.
 - a. Location: Mark walls in accessible concealed floor, floor-ceiling, and attic spaces.
 - b. Spacing: Markings shall be located within 15 feet (5 m) of the end of each wall and at intervals not exceeding 30 feet (10 m) measured horizontally along the wall or partition.
 - c. Lettering: Stenciled letters a minimum of 3 inches (76 mm) in height with a minimum 3/8 inch stroke in a color contrasting with the wall material (typically black) paint. Markings shall be one of the following, appropriate to the partition type, as indicated on plans.
 - 1) "SMOKE PARTITION – PROTECT ALL OPENINGS".
 - 2) "#-HR FIRE BARRIER – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.
 - 3) "#-HR FIRE WALL – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16

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SECTION 09 24 00 - CEMENT PLASTERING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cement plastering.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Wood stud framing for plaster.
 - 2. Section 07 27 26 - Fluid-Applied Air Barrier System.
 - 3. Section 08 31 00 - Access Doors and Panels: Access panels.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Acoustical sealing in conjunction with metal stud framing and furring for plaster.
 - 5. Section 09 22 36 - Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.

1.3 REFERENCE STANDARDS

- A. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- C. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2014 (Reapproved 2022).
- D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.
- E. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters; 2015 (Reapproved 2020).
- F. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2024.
- G. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006 (Reapproved 2024).
- H. ASTM C1328/C1328M - Standard Specification for Plastic (Stucco) Cement; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittals procedures.
- B. Product Data: Provide data on plaster materials and trim accessories.
- C. Samples:
 - 1. Submit two samples, 6 by 6 inches (152 by 152 mm) in size illustrating finish color and texture.
 - 2. Submit two samples of each type trim accessory.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.6 MOCK-UPS

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-Up Panel: Construct a 4 foot wide by 8 foot high (1200 mm wide by 2400 mm high) sample panel of plaster work at the jobsite demonstrating installation procedures, finish texture, and color. Show each phase of installation including framing and reinforcement.
- C. Construct mock-up of exterior and interior wall, 3 feet (1 m) long by 3 feet (1 m) wide, illustrating surface finish.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of this work.

1.7 FIELD CONDITIONS

- A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F (4 degrees C) or lower, or when temperature is expected to drop below 40 degrees F (4 degrees C) within 48 hours of application.
- B. Interior Plaster Work: Maintain minimum ambient temperature of 50 degrees F (10 degrees C) during installation of plaster and until fully cured.

PART 2 PRODUCTS

2.1 CEMENT PLASTER APPLICATIONS

- A. Lath Plaster Base: Metal lath.
 - 1. Plaster Type: Factory prepared plaster mix.
 - 2. Number of Coats: Three.
 - 3. First Coat: Apply to a nominal thickness of 3/8 inch (9 mm).
 - 4. Second Coat: Apply to a nominal thickness of 3/8 inch (9 mm).
 - 5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch (0.79 to 1.6 mm).
 - 6. Finish Coat: Apply to a nominal thickness of 1/8 inch (3 mm).
 - a. Texture: _____.
- B. Solid Plaster Base: Concrete masonry.
 - 1. Plaster Type: Jobsite mixed plaster.
 - 2. Number of Coats: Three.
 - 3. First Coat: Apply to a nominal thickness of 1/4 inch (6 mm).
 - 4. Second Coat: Apply to a nominal thickness of 1/4 inch (6 mm).
 - 5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch (0.79 to 1.6 mm).
 - 6. Finish Coat: Apply to a nominal thickness of 1/8 inch (3 mm).
 - a. Texture: _____.

2.2 FACTORY PREPARED CEMENT PLASTER

- A. Exterior Portland cement plaster system made of scratch and brown base coat, leveling coat with reinforcing mesh, and acrylic finish coat; install in accordance with ASTM C926.
 - 1. Provide continuous exterior insulation as part of the system, by the same manufacturer.
 - 2. Provide weather resistive barrier as part of the system, by the same manufacturer.
 - 3. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Dryvit Systems, Inc: www.dryvit.com/systems/stucco.
 - 2) LaHabra: www.lahabrastucco.com.
 - 3) Master Wall, Inc: www.masterwall.com.
 - 4) Sika Corporation: www.usa.sika.com/en/construction/eifs-stucco.html.
 - 5) Sto Corp: www.stocorp.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

- 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
4. Basis of Design Product:
 - B. Premixed One-Coat Base: Mixture of Type I Portland cement complying with ASTM C150/C150M, hydrated lime complying with ASTM C207, fibers and other approved ingredients; install in accordance with ASTM C926.
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Magna Wall, an Oldcastle brand: www.magnawall.com.
 - 2) Mapei Corporation: www.mapei.com.
 - 3) The QUIKRETE Companies: www.quikrete.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 2. Basis of Design Products:
 - C. Premixed Base Coats: Mixture of cement, aggregate, fibers, and proprietary admixtures for scratch and brown coats; install in accordance with ASTM C926.
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Amerimix, an Oldcastle APG brand: www.amerimix.com.
 - 2) The QUIKRETE Companies: www.quikrete.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 2. Basis of Design Products:
 - D. Premixed Leveling Coat: Acrylic polymer-based blend approved for use with plaster manufacturer's base coat and finish materials.
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 2. Basis of Design Products:
 - E. Premixed Finish Coating: Same product as base coat.

2.3 JOBSITE MIXED CEMENT PLASTER

- A. Materials:
 1. Portland Cement: ASTM C150/C150M, Type I.
 - a. Finish Coat: White color.
 2. Masonry Cement: ASTM C91/C91M, Type N.

3. Plastic Cement: ASTM C1328/C1328M.
 4. Lime: ASTM C206 Type S.
 5. Sand: Clean, well graded, and complying with ASTM C897.
 6. Water: Clean, fresh, potable, and free of mineral or organic matter that could adversely affect plaster.
- B. Plaster Mixes: Proportioned in accordance with ASTM C926; parts by volume.
1. First Coat Over Lath:
 - a. Minimum 2-1/2 parts and maximum 4 parts sand, per total volume of cementitious materials.

2.4 ACCESSORIES

- A. Lath: Refer to Section 09 22 36 - Lath.
- B. Finishing Accessories: Refer to Section 09 22 36 - Lath.
- C. Bonding Compound: Provide type recommended for bonding plaster to solid surfaces, complying with ASTM C932.
- D. Reinforcing Mesh: 4.5 oz/sq yd (153 g/sq m) alkali-resistant mesh.
- E. Water-Resistive Barrier: See Section 07 25 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- C. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

3.2 PREPARATION

- A. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.

3.3 MIXING

- A. Mix only as much plaster as can be used prior to initial set.
- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Do not retemper mixes after initial set has occurred.
- D. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.4 APPLICATION

- A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- B. Leveling Coat:
 1. Apply leveling coat to specified thickness.
 2. Fully embed reinforcing mesh in leveling coat.
- C. Finish Coats:
 1. Cement Plaster:
 - a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
 - b. Apply desired surface texture while mix is still workable.
 - c. Float to a consistent finish.

3.5 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet (6 mm in 3 m).

3.6 REPAIR

- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION 09 24 00

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SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Stone Tile.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
 - 2. Section 07 95 13 - Expansion Joint Cover Assemblies: Expansion joint components.
 - 3. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
 - 4. Section 22 40 00 - Plumbing Fixtures: Shower receptor.

1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.

- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- O. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- P. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- Q. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.
- R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Tile: 1 percent of each size, color, and surface finish combination.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial B Contractor (light commercial): www.naturalstoneinstitute.org.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - 2. Installer Certification:

1.7 MOCK-UP

- A. Refer to Section 01 40 00 - Quality Requirements for general requirements for mock-up.

- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Stone Tile:
 - a. Stone Source, Inc.
 - 2. Tile Setting and Grout Materials: Those manufactured by tile manufacturers named above or any of the following as approved by tile manufacturer for use with their tile and to suit application.
 - a. ARDEX Engineered Cements: www.ardexamericas.com.
 - b. Bostik Inc: www.bostik-us.com.
 - c. Custom Building Products: www.custombuildingproducts.com.
 - d. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
 - e. LATICRETE International, Inc: www.laticrete.com.
 - f. Mapei Americas: www.mapei.com.
 - g. Merkrete, by Parex USA, Inc: www.merkrete.com.
 - h. Texrite: www.texrite.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 TILE SCHEDULE

- A. Tile Type T-1 - Light Grey:
 - 1. Basis of Design:
 - a. Products manufactured by Stone Source, Inc.
 - b. Line: Trend Origina.
 - c. Color: 660 Pietra Serena.
 - d. Finish: Polished.
 - 2. Material: Stone.
 - 3. Size: 16 by 48 inches.
- B. Tile Type T-2 - White:
 - 1. Basis of Design:
 - a. Products manufactured by Stone Source, Inc.
 - b. Line: Trend Origina.
 - c. Color: 655 White Star.
 - d. Finish: Polished.
 - 2. Material: Stone.
 - 3. Size: 16 by 3 inches.

- C. Tile Type T-3 - Dark Grey:
 - 1. Basis of Design:
 - a. Products manufactured by Stone Source, Inc.
 - b. Line: Trend Origina.
 - c. Color: 1650 Graphite Luster.
 - d. Finish: _____.
 - 2. Material: Stone.
 - 3. Size: 24 by 60 inches.

2.3 STONE TILE

- A. Artificial Stone Tile:
 - 1. Composition: 93 percent quartz aggregate, resin, color pigments.
 - 2. Moisture Absorption: 0 to 0.3 percent as tested in accordance with ASTM C373.
 - 3. Size: As scheduled.
 - 4. Thickness: Refer to Basis of Design product.
 - 5. Surface Finish: As scheduled.
 - 6. Color(s): As scheduled.

2.4 TRIM AND ACCESSORIES

- A. Metal Trim: Refer to Section 05 75 00 - Decorative Formed Metal.

2.5 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.

2.6 GROUTS

- A. Provide setting and grout materials from same manufacturer.

2.7 ACCESSORY MATERIALS

- A. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide, alkali-resistant, coated glass fiber mesh tape for joints and corners.
 - 1. Basis of Design Product(s):
- B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - 1. Standard Type: Thickness 1/2 inch (12.7 mm).
 - 2. Fire Resistant Type: Type X core, thickness 5/8 inch (15.9 mm).
 - 3. Basis of Design Product(s):
- C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
- B. Over wood substrate with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with standard grout.

3.5 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
- B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.6 CLEANING

- A. Clean tile and grout surfaces.

3.7 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Suspended metal grid ceiling system.
 - 2. Acoustical units.
 - 3. Supplementary acoustical insulation above ceiling.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 07 21 00 - Thermal Insulation; Acoustical insulation.
 - 3. Section 08 31 00 - Access Doors and Panels: Access panels.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023e.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- L. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.
- M. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.
- N. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- O. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

- P. CHPS (HPPD) - High Performance Products Database; Current Edition.
- Q. ISO 14644-1 - Cleanrooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness by Particle Concentration; 2015.
- R. ITS (DIR) - Directory of Listed Products; Current Edition.
- S. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.
- U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit two samples 6 by 6 inch (150 by 150 mm) in size illustrating material and finish of acoustical units, including edge.
- F. Samples: Submit two samples each, 6 inches (150 mm) long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of each type installed, to a minimum of one box of each..

1.6 QUALITY ASSURANCE

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 55 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Acoustic Panels:
 - a. Armstrong World Industries, Inc.: www.armstrongceilings.com.
 - b. Acoustic Ceiling Products, Inc.: www.acpideas.com.
 - c. Acoustics First Corporation: www.acousticsfirst.com.
 - d. CertainTeed Corporation: www.certainteed.com.
 - e. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - f. Nelson Industrial, Inc: www.nelsonii.com/arch.
 - g. TECHLITE: www.techlite.com.
 - h. USG Corporation: www.usg.com/ceilings.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PANELS

- A. General Requirements: ASTM E1264, Class A.
 - 1. VOC Content: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
 - b. Product listing in CHPS (HPPD).
- B. Acoustical Ceiling Panels, ACP-1: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Basis of Design:
 - a. Ultima High NRC manufactured by Armstrong World Industries, Inc.
 - 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 3. Size: 24 x 24 x 1 inches.
 - 4. Minimum NRC: 0.85, determined in accordance with ASTM E1264.
 - 5. Minimum Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 6. Panel Edge: Beveled Tegalur.
 - 7. Color: As indicated on Drawings.
 - 8. Suspension System: Exposed.

2.3 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 - 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
 - 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - 2. Profile: Tee; 15/16 inch (24 mm) face width.
 - 3. Finish: Baked enamel.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Acoustical Insulation: Refer to Section 07 21 00 - Thermal Insulation.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected plan.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.
- K. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.

- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 8 ft (2.5 m) of an exterior door.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00

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SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient tile flooring
 - 2. Installation accessories.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
 - 3. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
 - 4. Division 26: Electrical floor cover plates for installation of resilient flooring specified in this section.

1.3 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.
- D. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2022.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Verification Samples: Submit two samples, 6 by 6 inch (150 by 150 mm) in size illustrating color and pattern for each resilient flooring product specified.
- E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 78 23 - Operation and Maintenance Data for additional provisions.
 - 2. Extra Flooring Material: Provide extra flooring material equal to 1 percent of each type and color of installed flooring, minimum of 10 square feet (1 square meters).

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Do not double stack pallets.

1.7 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 GENERAL REQUIREMENTS

- A. Unless noted otherwise, all Resilient Flooring shall comply with the following:
 - 1. VOC Content Limits: As specified in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.3 RESILIENT TILE FLOORING

- A. General Requirements:
 - 1. Size(s): As indicated on Drawings.
- B. Vinyl Tile - RFT-1, RFT-2: Printed film type, with transparent or translucent wear layer.
 - 1. Manufacturers: Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Armstrong Flooring: www.armstrongflooring.com.
 - b. Burke Flooring: www.burkeflooring.com.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - d. Roppe Corporation: www.roppe.com.
 - 2. Basis of Design:
 - a. RFT-1:
 - 1) Manufacturer: Mannington.
 - 2) Line: No Reservations Express.
 - 3) Pattern: Stone
 - 4) Color: Audacious NR201.
 - 5) Size: 12 by 24 inches.
 - b. RFT-2:
 - 1) Manufacturer: Mannington.
 - 2) Line: [No Reservations Express].

- 3) Pattern: Abstract.
- 4) Color: Stoic NR301.
- 5) Size: 6 by 36 inches.
3. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
4. NSF 332 Certification: Platinum level.
5. Wear Layer Thickness: 0.020 inch (0.50 mm).
6. Total Thickness: 0.125 inch (3 mm).

2.4 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Adhesive for Vinyl and Rubber Flooring:
 1. Manufacturers: Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- C. Moldings, Transition and Edge Strips:
 1. Metal Moldings, Transition and Edge Strips: Refer to Section 05 75 00 - Decorative Formed Metal.
 2. Resilient Moldings, Transition and Edge Strips: Refer to Section 09 65 13 - Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 2. Resilient Strips: Attach to substrate using adhesive.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- F. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 65 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base, adhesive attached, in locations shown on drawings.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors, for the Architect's selection (if selections are not already scheduled or otherwise indicated on the drawings).
 - 2. Actual 12 inch (305 mm) long piece of base material in each color selected for approval.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Burke Collection, a part of Mannington Commercial; www.manningtoncommercial.com/burke.
 - 2. Flexco Floors; www.flexcofloors.com.
 - 3. Johnsonite, a Tarkett USA brand; www.commercial.tarkett.com.
 - 4. Nora, by Interface; www.nora.com.
 - 5. Roppe Corporation; www.roppe.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (RB-1):
 - 1. Basis of Design Products:
 - a. Products manufactured by Burke Flooring.

- b. Products manufactured by Flexco Floors.
 - c. Products manufactured by Johnsonite.
 - d. Products manufactured by Nora.
 - e. Products manufactured by Roppe Corporation.
- 2. Quality Standard: ASTM F1861.
- 3. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
- 4. Manufacturing Method: Group I (solid, homogeneous)
- 5. Style: Topset cove; rolls of greatest length available, cut to length required to minimize joints.
- 6. Minimum Thickness: Full 1/8 inch (3 mm).
- 7. Color: 161 Snow.
- 8. Height: 4 inches, unless indicated otherwise
- 9. Corners: Job-Formed.
- B. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- C. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.4 EXTRA STOCK

- A. Deliver to the Owner:
 - 1. 1 percent, or one unopened carton of each color, type and size of base selected, whichever is greater.
 - 2. One (1) gallon container of each type adhesive used for base.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to the Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare substrates to receive base as recommended by base manufacturer.
- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 - 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
 - 1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 - 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by the Architect.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION 09 65 13

SECTION 09 67 00 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Fluid-applied, epoxy resin flooring system.
 - 2. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- B. ASTM D4263 - Standard Practice for Indicating Moisture in Concrete by the Plastic Sheet Method; 2024.
- C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Comparable Product.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated include manufacturer's technical data, application instructions, and recommendations for each flooring component required.
- B. Samples: Submit flooring system required, 6 inches (150 mm) square, applied to a rigid backing.
 - 1. Two samples indicating range of slip resistant textures
 - 2. Two samples of actual color and texture selected by Architect.
- C. Reports and Certificates:
 - 1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Maintenance Data: Submit data for flooring system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of the IBC for interior floors.

2. Fire Test Response Characteristics: Determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 3. Accessibility Requirements: Comply with applicable requirements.
 4. Flammability: Self-extinguishing according to ASTM D635.
- B. Installer Qualifications: Installer having minimum 5 years documented experience in the installation of epoxy floors and who is a manufacturer authorized representative trained and approved for installation of flooring systems required. Engage installer certified in writing by floor manufacturer as qualified to apply flooring systems indicated.
- C. Source Limitations: Obtain primary flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- D. Pre-Installation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.9 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full year from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Sherwin-Williams Company (The), High Performance Flooring: industrial.sherwin-williams.com/na/us/en/resin-flooring.html.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 FLUID-APPLIED, EPOXY RESIN FLOORING SYSTEM (FF-1)

- A. Basis of Design:
 - 1. Hybri-Flex EC manufactured by The Sherwin-Williams Company.
- B. Flooring System:
 - 1. Epoxy/Aliphatic Urethane with flake broadcast.
- C. Color:
 - 1. Resin: GP6750FBN Bottlenose.
 - 2. Flake: 1/4-inch.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Remove existing floor covering, adhesives, and contaminates. Ensure existing concrete floor is ready to receive epoxy floor covering.
 - 2. Roughen concrete by Shot Blasting (mechanical preparation only) substrates complying with manufacturer's written instructions.
 - 3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 4. Verify that concrete substrates are dry and moisture vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1,000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - b. Plastic Sheet Test: ASTM D4263. Proceed with application after testing indicates absence of moisture in substrates.
 - c. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 5. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Epoxy Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer/Waterproofing Membrane: Apply primer or waterproofing membrane over entire substrate surface in manufacturer's recommended thickness.
 1. Apply to integral cove base substrates.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Do not broadcast into cove. Mix quartz aggregates and add thixotropic and hand trowel. Round internal and external corners.
- D. Quartz Granules: Broadcast Quartz into Undercoat. Scrape off and vacuum up excess aggregate.
- E. Topcoats: Trowel or squeegee apply clear epoxy resin coat topcoats indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 48 hours.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

3.5 CLEANING

- A. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION 09 67 00

SECTION 09 81 00 - ACOUSTIC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiberglass batt acoustical insulation.
 - 2. Sprayed cellulose fiber acoustical insulation.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies: Acoustically-rated partitions.
 - 2. Section 09 90 00 - Painting and Coating: Painting of spray-applied acoustic insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023e.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- G. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- H. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

1.4 SYSTEMS DESCRIPTION

- A. Contractor must use a total system, encompassing equipment, fiber and adhesive as supplied and tested by the manufacturer. No substitution.
- B. Fibers supplied under this Section shall have each bag coded with the date and lot number of manufactures and retained samples shall be kept by the manufacturer for not less than 1 year.
- C. Contractor must be licensed and trained by the manufacturer.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification:
 - 1. Manufacturer's certificate that the product meets or exceeds specified requirements.
 - 2. Manufacturer's written certification that product contains no asbestos, and that sprayed-cellulose fiber acoustical insulation contains no fiberglass or other man made mineral fibers.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers.
 - 2. Suppliers.
 - 3. Installers/Applicators.

1.7 MOCK-UPS

- A. Batt Insulation: Not required
- B. Spray-Applied Insulation: A representative surface of not less than 100 square feet shall be sprayed and approved by the Architect prior to proceeding with finished work.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials off ground, under cover and away from damp surfaces and keep material dry at all times.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Batt Insulation:
 - a. CertainTeed, LLC: www.certainteed.com.
 - b. Johns Manville, a Berkshire Hathaway Company: www.jm.com.
 - c. Knauf: knauf.com.
 - d. Owens Corning: www.owenscorning.com.
 - 2. Spray-Applied Acoustic Insulation:
 - a. International Cellulose Corporation: www.spray-on.com.
 - b. Monoglass Incorporated: www.monoglass.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Acoustic Glass Batt Insulation for Use in Partitions and Over Acoustical Panel Ceilings:
 - 1. Basis of Design:
 - a. CertaPro AcoustaTherm manufactured by CertainTeed Corp.
 - b. Thermal & Sound Control Batts manufactured by Guardian Fiberglass, Inc.
 - c. Sound-SHIELD Sound Control Batts manufactured by Johns-Manville.
 - d. EcoBatt with ECOSE manufactured by Knauf.
 - e. Sonobatts (above ceiling) and Sound Batt (partitions) manufactured by Owens-Corning.
 - 2. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 3. Thickness (minimum):
 - a. 3-1/2 inches where indicated on Drawings.
 - b. 6 inches above Acoustic Ceiling Systems as indicated on Drawings.
- B. Acoustic Glass Batt Insulation for Use over Open Ceiling Panels:
 - 1. Basis of Design: SelectSound Black Acoustic Blanket manufactured by Owens-Corning.

2. Type: ASTM C553, Types I and II.
 3. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 4. Acoustical Performance:
 - a. ASTM C423; Mounting Type A: Material placed against solid backing.
 - b. Noise Reduction Coefficient (NRC): 0.75 or 0.90 as indicated in Drawings.
 5. Thickness (minimum):
 - a. 1 inches (NRC 0.75).
 - b. 2 inches (NRC 0.90).
- C. Acoustic Glass Board Insulation:
1. Basis of Design:
 - a. SelectSound Black Acoustic Board manufactured by Owens-Corning.
 2. Type: ASTM C612 types IA and IB.
 3. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 4. Acoustical Performance:
 - a. ASTM C423; Mounting Type A: Material placed against solid backing.
 - b. Noise Reduction Coefficient (NRC): 0.75 or 1.00 as indicated in Drawings.
 5. Thickness (minimum):
 - a. 1 inches (NRC 0.75).
 - b. 2 inches (NRC 1.00).
- D. Spray-Applied Acoustic Insulation:
1. Color: Black, unless noted otherwise.
 2. Field-tested bond strength report per ASTM E736/E736M: Tested at over 5 years / Not less than 400 psf / Not less than 600 times its weight at one (1) inch
 3. Fire Resistance per ASTM E84: Tested at a minimum of five (5) inch thickness, Class I
 - a. Flame Spread: Not To Exceed Five (5).
 - b. Smoke Development: Not To Exceed Five (5).
 4. Sprayed insulation shall meet appropriate Building Code Requirements.
 5. Thickness: 1-1/2 inch minimum typical. Thickness shall be determined in accordance with ASTM E605/E605M field test procedure.
 6. Bond Deflection per ASTM E759/E759M: 6 inch deflection in 10 foot span - no spalling or delamination.
 7. Cohesive Strength at time of application per Method WS-2000: >700 Grams.
 8. Basis of Design: "K-13 Spray-On-Systems" manufactured by International Cellulose Corporation.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine all surfaces and report all unsatisfactory conditions in writing to Architect. The work shall not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Provide masking, drop cloths or other satisfactory coverings for all materials/surfaces, which are not to receive insulation to prevent damage from over-spray.
- B. Surfaces to receive spray insulation shall be inspected prior to application to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains. Prime accordingly.

- C. Work shall be coordinated with other trades whose work may be affected or have an effect on the installation of the sprayed cellulose fiber.

3.3 INSTALLATION

- A. Installation, clean up and curing shall be accomplished according to the manufacturer's recommendations and common construction standards.
- B. Provide natural or mechanical ventilation continuously to properly cure the insulation.

3.4 PROTECTION

- A. Protect finished installation from damage caused by work of other trades.

END OF SECTION 09 81 00

SECTION 09 84 00 - ACOUSTIC ROOM COMPONENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cementitious wood fiber panels
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal supports.

1.3 REFERENCES

- A. ASTM C365/C365M - Standard Test Method for Flatwise Compressive Properties of Sandwich Cores; 2022.
- B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023e.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. ASTM E1111/E1111M - Standard Test Method for Measuring the Interzone Attenuation of Open Office Components; 2014 (Reapproved 2022).
- G. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.
- C. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect's selection.

1.5 QUALITY ASSURANCE

- A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.
- C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Carefully protect work during shipment, storage and installation.
- B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Wood Fiber Acoustical Panels:
 - a. Tectum, a division of Armstrong World Industries, Inc.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

- A. Cementitious Wood Fiber Panels:
 - 1. Acoustical Room Component Type 13 (ARC-13): Cementitious Wood Fiber Panels
 - a. Basis of Design: "Tectum Finale" manufactured by Armstrong World Industries, Inc.
 - b. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - c. Thickness: As indicated on Drawings.
 - d. Edge:
 - 1) Long Edge: As indicated on Drawings.
 - 2) Short Edge: As indicated on Drawings.
 - e. NRC: 0.40.
 - f. Size:
 - 1) Walls: As indicated on Drawings.
 - 2) Ceilings: 59-3/4 inches by 59-3/4 inches.
 - g. Frame: None.
 - h. Color: As selected by Architect.
 - i. Mounting Style: As indicated on Drawings.
 - j. Location: As indicated on Drawings.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify dimensions to insure proper fabrication of materials.

3.2 INSTALLATION

- A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.
- B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.
- C. Install Tectum Wall Panels on Natatorium walls with venting space between the wall and panels in accordance with manufacturer's instructions.
- D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.

- E. Arrange wall panels symmetrically on each wall, unless otherwise indicated, Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

END OF SECTION 09 84 00

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SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Surface preparation and field painting of exposed items and surfaces.
 - 2. Field preparation and painting of factory primed metal products and fabrications.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.
- D. ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry; 2011 (Reapproved 2018).
- E. ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings; 1994.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- H. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.4 DEFINITIONS

- A. Standard coating terms defined in ASTM D16 apply.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 - 2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
 - 3. Semi-gloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
 - 4. Gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.5 SUBMITTALS

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
 - 2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.

- B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
 - 1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
 - 3. Submit samples on following substrates for review of color and texture only:
 - a. Concrete: Provide two 4 inch square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4 inch x 8 inch samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
 - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.
- C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
 - 2. Performance and Durability:
 - a. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - b. ASTM D2486 Standard Test Method for Scrub Resistance of Interior Wall Paint.
 - c. ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
 - d. ASTM D4828 Standard Test Method for Practical Washability of Organic Coatings.
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.8 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
 - 1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).
- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
 1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860 lux) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.9 WARRANTY

- A. Written warranty signed by the manufacturer and the installer in which the manufacture and installer agree to repair or replace paint and primers that fail within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Flaking or delamination of paint with the substrate.
 - b. Rust, scale, similar imperfections due to improper surface preparation.
 - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
 - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
 - e. Deterioration or loss of color of paint beyond normal weathering.
 2. Warranty Period: One year from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. PPG Industries, Inc.: www.ppgpaints.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Basis of Specifications: PPG Industries, Inc.
- B. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- C. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified

manufacturers. Furnish product technical data, including percent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.

- D. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- E. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.
- F. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.
- G. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and SCAQMD 1113.
 - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA and SCAQMD 1113.
- H. Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- I. Patching Materials: Latex filler compatible with paint systems.
- J. Fastener Head Cover Materials: Latex filler.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
 - 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 PAINT COLOR SCHEDULE

- A. Colors (P-#):
 - 1. P-1 - White:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1001-1 Delicate White.
 - c. Sheen: Flat.
 - d. Locations: All gypsum board ceilings and soffits unless noted otherwise.
 - 2. P-2 - White:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1001-1 Delicate White.
 - c. Sheen: Semi-gloss.
 - d. Locations: All gypsum board walls unless noted otherwise.

3. P-3 - Blue:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1155-7 Blue Lava.
 - c. Sheen: Semi-gloss.
 - d. Locations: As indicated on Drawings.
4. P-4 - Green:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1030-4 Edamame.
 - c. Sheen: Semi-gloss.
 - d. Locations: As indicated on Drawings.
5. P-5 - Beige:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1097-3 Toasted Almond.
 - c. Sheen: Semi-gloss.
 - d. Locations: As indicated on Drawings.
6. P-6 - Grey:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: PPG1039-4 Pachyderm.
 - c. Sheen: Semi-gloss.
 - d. Locations: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Fiber Cement Board: 12 percent.
 - c. Masonry (Clay and CMUs): 12 percent.
 - d. Wood: 15 percent.
 - e. Gypsum Board: 12 percent.
 - f. Plaster: 12 percent.
 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. Gypsum Board Substrates: Verify taped joints are tapes and finishing compound is sanded smooth.
- D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.
- E. Spray Textured Ceiling Substrates: Verify surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
 - a. Note: Previously painted surfaces have failed to accept new paint systems. Determined cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.

- G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
1. All ferrous metal.
 2. All exterior galvanized metal.
 3. All exterior wood.
 4. All interior wood.
 5. All prime coated hardware.
 6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 7. All metal grilles, except aluminum, unless otherwise indicated.
 8. All exposed gypsum board surfaces, including all mechanical rooms.
 9. Miscellaneous other items which normally require painting or are scheduled to be painted.
 10. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 11. All exposed mechanical equipment and electrical equipment.
 12. Traffic lanes and parking spaces including fire lanes and crosswalks.
 13. Rolling doors.
 14. Bollards.
 15. Loose lintels.
 16. Refer to MEP specifications for additional items to receive paint.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
1. Pre-Primed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or pre-primed substrates.
 2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
 3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
 4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight

- of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
 5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
 2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 5. Aluminum Substrates: Remove surface oxidation.
- D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.
- E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
1. Remove surface film preventing proper adhesion and bond.
 2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
 3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
 4. Clean corroded iron and steel surfaces.
 5. Repair and blend into portland cement plaster.
 6. Prime bare surfaces.
 7. Tone varnished surfaces with stain bringing to uniform color.

8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.
- G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
 2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
 - a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
 - b. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.3 kg of water/92.9 sq. m).
 - c. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
 - d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
 - e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
 3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.
- H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.
- K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

- M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar defects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
 - 1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 - 2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 - 3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
 - 4. Allow patching and repair compounds to set and cure before painting.
- N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- O. Wood Substrates:
 - 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - 4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 - 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.
- Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
 - 1. Assure compatibility with product of wall covering manufacturer.
 - 2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
 - 3. Apply release coat in accordance with manufacturer's recommendations.
- R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.
- S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Do not use thinners for water based paints.
 - 4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
 - 1. The term exposed surfaces includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
 - 2. Use applicators and techniques suited for paint and substrate indicated.
 - 3. Provide finish coats compatible with primers.
 - 4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
 - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
 - b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
 - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
 - 11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - 12. Provide finish coats compatible with primers used.
 - 13. Sand lightly between each succeeding enamel or varnish coat.
- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.

- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
 3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
 7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.
- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.
1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
 2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.
- I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
 2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
 2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
 3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
 4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply

additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

- A. It is of the utmost important to the Owner that the sites remain in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.
- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

PART 4 SCHEDULES

4.1 GENERAL

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Overhead Painting (Ceilings, Exposed to Structure Above, etc.):
 - 1. Use a dryfall system comparable to system defined below for substrate.

4.2 PPG APPLICATION SCHEDULES

- A. Exterior:
 - 1. Galvanized Metal:
 - a. Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - 2. Field Weld Touch-Up on Galvanized Metal:
 - a. Two (2) coats Speedhide Int/Ext Galvanized Steel Primer, 6-209 Series.
 - 3. Shop-Primed Ferrous Metals:
 - a. Clean all bare and abraded areas to bright, bare metal and touch up with either:
 - 4. Wood (Painted Finish):
 - a. One (1) coat Seal Grip Int/Ext Acrylic universal Primer/Sealer 17-921.
 - 5. Concrete Block (Flat, smooth finish CMU):
 - a. One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series.
- B. Interior:
 - 1. Gypsum Board Walls:
 - a. Ceilings and locations not scheduled to receive enamel finish.
 - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.
 - b. Walls scheduled to receive enamel paint.
 - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.

2. Wood (Painted):
 - a. One (1) coat Seal Grip Interior/Ext Acrylic Universal Primer/Sealer 17-921
3. Wood (Stained):
 - a. Two (2) coats Deft Interior Water-Based Gloss Polyurethane DFT158.
4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 - a. Shop coat by others.
 - b. Touch up bare areas with Pitt Tech Plus Int/Ext DTM Primer, 90-912 Series.
 - c. One (1) coat Pitt Tech Plus Int/Ext DTM Primer 90-912.
 - d. Two (2) coats Pitt Tech Plus Int/Ext DTM Semi-Gloss Industrial 90-1210.
5. Galvanized Metals (Use for all exposed interior galvanized metal):
 - a. Clean and acid etch as necessary.
 - b. One (1) coat Pitt Tech Plus Int/Ext Industrial Primer, 90-912 Series.
 - c. Two (2) coats Pitt Tech Plus Int/Ext Industrial Semi-Gloss 90-1210.
6. Concrete Block (CMU):
 - a. General: Stop block filler and paint 1/2 inch below top of floor base material at all wall surfaces.
 - b. Latex Enamel (Corridors, Classrooms, Offices, and where shown on drawings):
 - 1) One (1) coat One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series.
7. Epoxy (Kitchen, and where shown on drawings):
 - a. One (1) coat Pitt-Glaze Int/Ext Block Filler Latex, 16-90 series.
 - b. Two (2) coats Pitt-Glaze WB1 Acrylic Epoxy Semi-Gloss 16-310 Series.

END OF SECTION 09 90 00

SECTION 09 97 23 - CONCRETE AND MASONRY COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Moisture resistant concrete coatings.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings; 2017 (Reapproved 2021).
- C. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2025.
- D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2025.
- E. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films; 2013 (Reapproved 2021).
- F. ASTM D2243 - Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings; 2020.
- G. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2025.
- H. ASTM D2370 - Standard Test Method for Tensile Properties of Organic Coatings; 2016 (Reapproved 2021).
- I. ASTM D4803 - Standard Test Method for Predicting Heat Buildup in PVC Building Products; 2024.
- J. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry; 2003 (Reapproved 2022).
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- M. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- N. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- O. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- P. SSPC-SP 3 - Power Tool Cleaning; 2024.
- Q. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- R. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating coating materials.
- C. Samples: Submit two samples ____ by ____ inch (____ by ____ mm) in size illustrating colors available for selection.

- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.6 MOCK-UP

- A. Provide mock-up, ____ feet (____ m) long by ____ feet (____ m) wide, illustrating coating, color, and surface sheen, for each specified coating.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.7 FIELD CONDITIONS

- A. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.
- D. Restrict traffic from area where coating is being applied or is curing.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

2.2 CONCRETE AND MASONRY COATINGS

- A. Provide high-build, weather resistant coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 - 1. Salt Spray Resistance: Passes when tested according to ASTM B117 for 2000 hours.
 - 2. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
 - 3. Accelerated Outdoor Exposure: Passes when tested according to ASTM G153 for 5,000 hours.
- B. Coatings - General: Provide complete systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.

1. Maximum volatile organic compound (VOC) content: As required by applicable regulations.
- C. System(s):
 1. Tilt-Up, Pre-Cast, and Cast-In-Place Concrete Coating System:
 - a. Basis of Design:
 - 1) TEX-COTE XL-70 "W" Textured Coating System manufactured by Textured Coatings of America, Inc.
 - b. Primer: As recommended by manufacturer.
 - c. Texture: As selected by Architect.
 - d. Color: As selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 16 percent.
- D. Masonry: Verify masonry joints are struck flush.

3.2 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Existing Painted and Sealed Surfaces:
 1. Strip existing paint and coatings from surface.
 2. Remove loose, flaking, and peeling paint. Feather edge and sand smooth edges of chipped paint.
 3. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.
- F. Ferrous Metal:
 1. Solvent clean.
 2. Remove loose rust, loose mill scale, and other foreign substances using hand tools according to SSPC-SP 2, power tools according to SSPC-SP 3, or blast cleaning according to SSPC-SP 6 or -SP 7.
- G. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.3 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Concrete and Masonry: Prior to priming, patch holes and indentations and fill cracks with manufacturer's recommended crack repair material.

3.4 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.

- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.5 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 PROTECTION

- A. Protect finished work from damage.

END OF SECTION 09 97 23

SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain enamel steel markerboards.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking and supports.
 - 2. Section 06 20 00 - Finish Carpentry: Wood frame and marker rails.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
 - 4. Section 09 90 00 - Painting and Coating: Finishing of wood frame and marker rail.
 - 5. Section 10 22 39 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- C. ANSI A208.1 - American National Standard for Particleboard; 2022.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- F. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- G. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics; 2025.
- M. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. PS 1 - Structural Plywood; 2023.
- P. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.

- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.
- E. Samples: Two, 2 by 2 inches (50 by 50 mm) in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surfacing, and trim.
- F. Test Reports: Show compliance to specified surface burning characteristics requirements.
- G. Manufacturer's printed installation instructions.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Data: Include data on regular cleaning, stain removal.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Fire Code:
 - a. Comply with applicable requirements of International Fire Code ICC (IFC).

2.3 VISUAL DISPLAY UNITS

- A. Porcelain Enamel Steel Markerboards:
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Same as for chalkboards.
 - 7. Frame: Extruded aluminum , with concealed fasteners.
 - 8. Frame Profile: As indicated on drawings.
 - 9. Frame Finish: Anodized, natural.
 - 10. Accessories: As indicated on drawings.As indicated on drawings.
 - 11. Basis of Design Product:

- a. Claridge Products and Equipment, Inc.; Model LCS3.

2.4 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).
- C. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.
- D. Steel Sheet Backing: 28 gauge, 0.0149 inch (0.38 mm), galvanized.
- E. Adhesives: Type used by manufacturer.

2.5 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
- B. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- C. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- D. Flag Holders: Cast aluminum bored to receive 1 inch (25 mm) diameter flag staff, bracketed to fit top rail of board.
- E. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- F. Marker Tray: Magnetic aluminum accessory tray.
- G. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.2 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
- C. Secure units level and plumb.
- D. Carefully cut holes in boards for thermostats.
- E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
 - 1. Fabricate re-wrapped edges where partial panels abut each other, or adjacent surfaces or trim.

2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
 - a. Wrap minimum 2 inches (51 mm) around back of panel.
 - b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.4 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.
- D. Break-in slate chalkboards with a chalk and clean treatment.

END OF SECTION 10 11 00

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room and door signs.
 - 2. Interior directional and informational signs.
 - 3. Emergency evacuation maps.
 - 4. Building identification signs.
- B. Related Sections:
 - 1. Section 05 51 00 - Metal Stairs: Photoluminescent stair nosings.
 - 2. Section 05 52 00 - Metal Railings: Photoluminescent handrail strips.
 - 3. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
 - 4. Section 26 05 53 - Identification for Electrical Systems.
 - 5. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.2 REFERENCE STANDARDS

- A. 19 TAC 61.1031 - School Safety Requirements; Current Edition.
- B. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- C. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- D. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- E. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- F. ACI 305R - Guide to Hot Weather Concreting; September 2020.
- G. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.
- H. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- I. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.
- J. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- K. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2024.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- M. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- N. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- O. AWS D1.6/D1.6M - Structural Welding Code—Stainless Steel; Current.
- P. California Building Code (CBC) - 2022 California Building Code, Title 24, Part 2; 2022.
- Q. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- S. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- T. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.
- U. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- V. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on Drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from the Owner through the Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by the Owner through the Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Flat Signs:
 - a. Best Sign Systems, Inc: www.bestsigns.com.
 - b. Cosco Industries: www.coscoarchitecturalsigns.com.
 - c. FASTSIGNS: www.fastsigns.com.
 - d. Inpro: www.inprocorp.com.
 - e. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - 2. Dimensional Letter Signs:
 - a. Cosco Industries: www.coscoarchitecturalsigns.com.
 - b. FASTSIGNS: www.fastsigns.com.
 - c. Inpro: www.inprocorp.com.

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 2. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:
 - (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
 - (b) ACI 301, "Specifications for Structural Concrete."
 - (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
 - (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
 - (e) ACI 305R, "Guide to Hot Weather Concreting."
 - (f) ACI 306R, "Guide to Cold Weather Concreting."
 - (g) ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.
 4. Woodworking Standards:
 - a. American National Standards Institute:
 - 1) ANSI A161.1 Woodwork Testing Standards.
 - b. Woodwork Institute:
 - 1) WI North American Architectural Woodwork Standards (current edition).
 - c. National Electrical Manufacturers Association:
 - 1) NEMA LD 3 High Pressure Decorative Laminates.

2.3 SIGNAGE APPLICATIONS

- A. Accessibility Compliance:
1. Signs are required to comply with ADA Standards, California Building Code (CBC), Florida Accessibility Code for Building Construction, and Texas Accessibility Standards (TAS) and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
1. Sign Type: Flat signs with engraved panel media as specified.
 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 3. Character Height: 1 inch (25 mm).
 4. Sign Height: 2 inches (50 mm), unless otherwise indicated.

5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide two additional areas or slots that allow for modifications and additions to the room signage to accommodate the flexibility of spaces.
 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide two additional areas or slots that allow for modifications and additions to the room signage to accommodate the flexibility of spaces.
 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Exterior Door Numbering: Provide numbering of exterior doors in compliance with 19 TAC 61.1031 and ICC (IFC) Section 505.
1. Fabrication:
 - a. Material: Retro-reflective vinyl characters applied to door system.
 - 1) Vinyl Basis of Design Product:
 - b. Characters: Arabic numerals or standard English alphabetical letters.
 - c. Font: Arial or similar sans serif.
 - d. Height: As indicated on Drawings, 4 inches (102 mm) minimum.
 - e. Stroke Width: 1/2 inch (12.7 mm), minimum.
 - f. Color: Black or White to contrast with background color.
 2. Locations: As indicated on Drawings.
- D. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
 2. Sign Type: Curved signs with engraved panel media as specified.
 3. Sizes: As indicated on Drawings.
 4. Allow for 20 signs 4 inches high by 16 inches long.
 5. Wording of signs is scheduled on Drawings.
 6. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- E. Emergency Evacuation Maps:
1. Provide maps where indicated on Drawings or as directed by the Architect or the Owner.
 2. Allow for one map per elevator lobby.
 3. Map content to be provided by the Architect.
 4. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- F. Building Identification Signs:
1. Use individual metal letters.
 2. Mount on outside wall in location indicated on Drawings.

2.4 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Square.
 3. Frame Finish: Natural (clear) anodized.
 4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
 5. Wall Mounting of One-Sided Signs: Tape adhesive.
 6. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.

7. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
- B. Color and Font: Unless otherwise indicated:
 1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: Clear.
 4. Character Color: Contrasting color.

2.5 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 1. Total Thickness: 1/16 inch (1.6 mm).
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
 1. Total Thickness: 1/8 inch (3 mm).
- C. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
 1. Total Thickness: 1/8 inch (3 mm).
 2. Letter Thickness: 1/8 inch (3 mm).
 3. Letter Edges: Square.

2.6 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
 1. Sign Color: Clear.
 2. Total Thickness: 1/8 inch (3 mm).
- B. Sand Blasted Plastic Panels: High gloss acrylic plastic; letters sand blasted to dull sheen:
 1. Total Thickness: 1/8 inch (3 mm).

2.7 DIMENSIONAL LETTERS

- A. Metal Letters:
 1. Metal: Aluminum plate.
 2. Metal Thickness: 1/8 inch minimum (3 mm).
 3. Letter Height: As indicated on Drawings.
 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 5. Finish: Brushed, satin.
 6. Mounting: Tape adhesive.

2.8 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Chrome plated.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Where signage is adhered to glazing and will be visible from the opposite side, provide a cover plate to obscure back of signage. Furnish and install cover in material, shape, and size to match signage.
- C. Install neatly, with horizontal edges level.
- D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- E. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 00

SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended, overhead curtain track and guides.
- B. Surface-mounted, overhead curtain track and guides.
- C. Cubicle curtains.
- D. Blackout curtains.

1.2 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Above ceiling track supports.
- B. Section 06 10 00 - Rough Carpentry: Above ceiling blocking and track supports for track.
- C. Section 09 51 00 - Acoustical Ceilings: Suspended ceiling system to support track.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Samples: Submit 12 inch (300 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
- F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Curtains: Two of each type and size.
 - 3. Extra Carriers: Ten.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. A. R. Nelson Co: www.arnelson.com/#sle.
2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
3. Imperial Fastener Co., Inc: www.imperialfastener.com/#sle.
4. Inpro: www.inprocorp.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
1. Profile: Channel.
 2. Mounting: Suspended.
 3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 4. Track End Stop: To fit track section.
 5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
 6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.
 7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
 8. Finish on Exposed Surfaces: Clear anodized.
 9. Products:
 - a. Construction Specialties, Inc.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
- C. Wand: Plastic, attached to lead carrier, for pull-to-close action.
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.3 CURTAINS

- A. Cubicle Curtains:
1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 3. Material: 100% Trevira CS.
 4. Color/Pattern: Ocean Mist.
 5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, white color.
 6. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
 7. Products:
 - a. Basis of Design: Provide RX8001 as manufactured by Architex, Inc.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Curtain Fabrication:
1. Width of curtain to be 10 percent wider than track length.
 2. Length of curtain to end 15 inches (380 mm) above finished floor.
 3. Railroad fabric without vertical seams.
 4. Pattern match fabric with vertical seams.
 5. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
 6. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches (150 mm) on center.

7. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install curtain track to be secure, rigid, and true.
- B. Refer to Section 05 50 00 - Metal Fabrications for track supports above ceiling.
- C. Refer to Section 06 10 00 - Rough Carpentry for blocking and track supports above ceiling.
- D. Secure track to ceiling system.
- E. Install end cap and stop device.
- F. Install curtains on carriers ensuring smooth operation.

END OF SECTION 10 21 23

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SECTION 10 22 19 - DEMOUNTABLE PARTITIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal stud framing system.
 - 2. Gypsum board partition panels.
 - 3. Frames for doors and glazed openings.
 - 4. Wall base.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
 - 2. Section 08 71 00 - Door Hardware.
 - 3. Section 09 90 00 - Painting and Coating: On-site painting.

1.3 REFERENCE STANDARDS

- A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2024.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- D. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- F. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, joints, and decorative finish.
- C. Shop Drawings: Indicate layout, module joint locations, and special details associated with acoustic seals.
- D. Samples: Submit two samples 12 by 12 inch (300 by 300 mm) in size illustrating wall covering facing and trim colors and finish.
- E. Manufacturer's Instructions: Indicate special procedures.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Safety Glazing Certification Council (SGCC).
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
 - a. North American Contractor Certification (NACC) for glazing contractors.
 - b. Equivalent independent third-party ANSI accredited certification.

1.6 MOCK-UP

- A. Construct mock-up of three panel modules, with one 90 degree corner, one "T" intersection, top cap, utility raceway, and joint treatment.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 1. Demountable Solid Partitions:
 - a. Avanti Systems USA: www.avantisystemsusa.com/#sle.
 - b. Gravity Lock Systems, Inc: www.gravitylock.com/#sle.
 - c. Haworth, Inc. 222haworth.com/#sle.
 - d. KI International: www.ki.com/#sle.
 - e. Ultrawall, LLC: www.ultrawall.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 DEMOUNTABLE SOLID PARTITIONS

- A. Partition System: Demountable, double sided, non-progressive, capable of four direction lateral expansion with reusable components.
 1. Module Width: As indicated on drawings.
 2. Partition Height: As indicated on drawings.
 3. Nominal Partition Thickness: 4 inches (100 mm).
 4. Joints: Vertical, butt joint.
 5. Utility Raceways: Provide access through posts, studs, cap channels, vertical support profiles, and floor and base channels.

2.3 DEMOUNTABLE GLASS PARTITIONS

- A. Basis of Design: Enclose manufactured by Haworth, Inc.
- B. Partition System: Demountable, single dry glazed, non-progressive, capable of four direction lateral expansion with reusable components.
 1. Module Width: As indicated on drawings.
 2. Partition Height: As indicated on drawings.
 3. Nominal Partition Thickness: 4 inches (100 mm).
 4. Joints: Vertical, batten with concealed fasteners.
 5. Utility Raceways: Provide access through posts, cap channels, vertical support profiles, and floor and base channels.
- C. Performance Requirements:
 1. Acoustic Attenuation: STC of 35 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.4 MATERIALS

- A. Standard Gypsum Board: ASTM C1396/C1396M, 3/8 inch (9.5 mm) thick, maximum permissible length; ends square cut, square edges.
- B. Glazing:
 - 1. Tempered Glass: Annealed flat glass meeting requirements of ASTM C1036, Type 1-Transparent Flat, Class 1-Clear, Quality Q3, and fully tempered in accordance with ASTM C1048, Kind FT.
 - a. Thickness: 1/4-inch.
 - b. Prepare glazing panels for indicated fittings and hardware before tempering.
 - c. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.
- C. Fasteners: Type recommended by system manufacturer.
- D. Panel Adhesive: Type recommended by system manufacturer.

2.5 PARTITION COMPONENTS

- A. Studs and Tracks: ASTM C645, sheet steel, 26 gauge, 0.0179 inch (0.45 mm) minimum thickness, C shaped, with serrated faces.
- B. Posts: Extruded aluminum, 14 gauge, 0.0641 inch (1.63 mm), thick.
- C. Panel Termination Trim: Formed steel.
 - 1. Finish: Prime painted for field finish.
 - 2. Color: As selected by Architect.
- D. Miscellaneous Trim: Snap-on accessories.
- E. Wall Base: Extruded aluminum.
 - 1. Height: To match adjacent base.
 - 2. Finish: Prime painted for field finish.
 - 3. Color: As selected by Architect.

2.6 DOOR AND WINDOW COMPONENTS

- A. Frames: Dimensional Logic Frames as manufactured by Haworth, Inc.
- B. Door Hardware: Manufacturer's standard.

2.7 FITTINGS AND HARDWARE

- A. Glass Partition Door Hardware: Refer to Section 08 71 00 - Door Hardware.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building conditions are ready to receive partitions and that field measured dimensions are as indicated on shop drawings.
- B. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

- A. Install partitions after placement of carpet.
- B. Partition Panels:
 - 1. Install panels in accordance with partition system manufacturer's instructions.
- C. Frames: Install in accordance with partition system manufacturer's instructions; erect vertical members plumb, and horizontal members level.
- D. Door Hardware: Install in accordance with partition system manufacturer's instructions.
- E. Wall Base: Install in accordance with partition system manufacturer's instructions.
- F. Field Finishing: Refer to Drawings and Section 09 90 00 - Painting and Coating.

3.3 TOLERANCES

- A. Maximum Variation from True Plane of Partition Surfaces: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.
- B. Maximum Variation from Dimensioned Locations: 1/4 inch (6 mm) in any direction.

3.4 ADJUSTING

- A. Adjust doors and frames to provide smooth door operation from open to closed position without gravity movement of door from any position.

3.5 PROTECTION

- A. Do not permit subsequent construction activities to cause damage to appearance or operation of installed partition components before Date of Substantial Completion.

END OF SECTION 10 22 19

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
 - 2. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.
 - 4. Section 09 72 00 - Wall Coverings: Terminating wall covering at wall and door protection.

1.3 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2024.
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.
- D. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- F. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- H. AWS D1.6/D1.6M - Structural Welding Code—Stainless Steel; Current.
- I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, 24 inches (610 mm) long.
- E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Stock Materials: One package(s) of minimum 96 inches (2438 mm) long unit of each kind of covers for corner guards.
- H. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures or internal connection failures.
 - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.
- C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.
 - 1. Failures include, but are not limited to, the following:
 - a. Detachment of rail system from substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Corner Guards:
 - a. Babcock-Davis: www.babcockdavis.com/#sle.
 - b. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - c. Inpro: www.inprocorp.com/#sle.
 - d. Koroseal Interior Products: www.koroseal.com/#sle.
 - e. Nystrom, Inc: www.nystrom.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Regulatory Requirements:
 - a. Code Standards:
 - 1) Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.4 PRODUCT TYPES

- A. Corner Guards - Surface Mounted, Stainless Steel:
 - 1. Basis of Design:
 - a. CO Series manufactured by Construction Specialties, Inc.
 - 2. Material: Type 304 stainless steel, finish, 16 gauge.
 - 3. Finish: No. 4 Satin.
 - 4. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 5. Width of Wings: 1 inch (25 mm).
 - 6. Corner: Square.
 - 7. Length: One piece, full height.
 - 8. Mounting: Clear adhesive.

2.5 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

2.6 SOURCE QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.2 INSTALLATION

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.4 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Washroom accessories.
 - 2. Toilet accessories.
 - 3. Accessories necessary for a complete installation.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- E. ASTM B16/B16M - Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines; Current.
- F. ASTM B19 - Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks; Current.
- G. ASTM B30 - Standard Specification for Copper Alloys in Ingot and Other Remelt Forms; Current.
- H. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.
- I. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.3 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 2. Include electrical characteristics.
- B. Samples: Provide a sample to demonstrate each exposed product finish specified.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. Texas Accessibility Standards (TAS).
- B. Source Limitations: Obtain products from single source from single manufacturer.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. AJW Architectural Products.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. Dyson: www.dyson.com.
 - 7. GAMCO Specialty Accessories; a division of Bobrick.
 - 8. Georgia Pacific.
 - 9. Tubular Specialties Manufacturing, Inc.
- B. Substitutions: Refer to 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A153/A153M, hot dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.3 COMPONENTS

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 1. Material and Finish: Antimicrobial, molded plastic, white.

2.4 FABRICATION

- A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 SCHEDULE

4.1 TOILET ACCESSORY SCHEDULE

- A. TA-1W - Soap Dispensers – Wall-Mounted (OFCI):
 - 1. Mounting: Surface.
 - 2. Basis of Design: LTX Liquid Soap Dispenser by Gojo.
 - 3. Locations: Where indicated on Drawings.
- B. TA-4 - Paper Towel Dispensers (OFCI):
 - 1. Mounting: Surface.
 - 2. Basis of Design: 34346 by Kimberly-Clark.
 - 3. Color: Black.
 - 4. Install: Surface mounted.
 - 5. Locations: Where indicated on Drawings.

END OF SECTION 10 28 00

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SECTION 10 43 00 - EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Automated external defibrillators (AEDs).
- B. Automated external defibrillator (AED) cabinets.
- C. First aid cabinets.
- D. Key boxes.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 DEFINITIONS

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

1.4 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.5 REFERENCES

- A. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- 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 schedules and recertification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Automated External Defibrillators (AEDs):
 - a. Philips Medical Systems: www.usa.philips.com.
 - b. Stryker Corporation: www.stryker.com.
 - c. ZOLL Medical Corporation: www.zoll.com.
 - 2. Emergency Aid Cabinets and Accessories:
 - a. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: www.activarcpg.com/#sle.

- b. Modern Metal Products, a division of Technico, Inc: www.modern-metal.com/#sle.
- 3. Key Boxes:
 - a. Knox Company: www.knoxbox.com/#sle.
- 4. AED Floor Marking Kits:
 - a. Insite Solutions, LLC: www.stop-painting.com/#sle.

2.2 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
 - 1. Automated external defibrillators (AEDs) shall be provided by Owner.

2.3 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED) and First aid.
 - 1. First Aid Basis of Design:
 - a. Provide SE1082 as manufactured by Flinn Scientific, Inc.
- B. Fire-Rated Cabinet Construction: One-hour fire rated.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
 - 2. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- C. Cabinet Configuration: Recessed, Semi-recessed, or Surface-mounted type as indicated on Drawings..
 - 1. Size each cabinet to accommodate AED or first aid kit as indicated on Drawings.
 - 2. Trim:
 - a. At Recessed Cabinets: Trimless type.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.
- E. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- I. Finish of Door Pull or Handle: Stainless steel.
- J. Finish of Cabinet Interior: White powder coat.

2.4 KEY BOXES

- A. Basis of Design: 3200 Series manufactured by Knox Company.
- B. Mounting: Fully-recessed, as indicated on drawings. Surface mounted units are not acceptable.
- C. Finish: Aluminum.

2.5 ACCESSORIES

- A. Cabinet Door Signage: "AED" decal, as required, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- B. AED Floor Marking Kits:
 - 1. Floor Marking Tape for AED Access Identification: Self-adhesive vinyl or polyester tape with overlamine, 2 inches (51 mm) wide, with "DO NOT BLOCK" on the 36 inch (914 mm) side strips and "AED" and AED icon on the 24 inch (610 mm) middle strip.
 - 2. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "AED" and AED icon.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. AED Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Secure rigidly in place.
 - 3. Place AEDs in cabinets.
- B. Cabinet Lettering:
 - 1. Location: Face of door framing.
 - 2. Apply lettering on factory-finished cabinets either at the factory or just prior to Substantial Completion.
- C. Key Box Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Location: As indicated on Drawings or as directed by Authorities Having Jurisdiction (AHJ).

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors to operate smoothly without binding.
- C. On completion of installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes. Replace products that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

3.4 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstrate proper operation of AED to Owner's designated representative.

END OF SECTION 10 43 00

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire extinguisher cabinets.
 - 2. Accessories.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
 - 2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- C. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- E. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- F. FM (AG) - FM Approval Guide; Current Edition.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- J. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- K. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- 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.

1.4 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Fire Extinguisher Cabinets and Accessories:

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Fire Code:
 - a. Comply with applicable requirements of International Fire Code ICC (IFC).
 - 4. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 FIRE EXTINGUISHER CABINETS

- A. General:
 - 1. Basis of Design: Provide Academy Series as manufactured by JL Industries.
 - 2. Size to accommodate indicated extinguisher and accessories.
 - 3. Doors:
 - a. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
 - b. Manufacturers standard Magnetic Closer.
 - 4. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - 5. Fabrication: Weld, fill, and grind components smooth.
 - 6. Finish of Cabinet Exterior Trim and Door: Baked enamel, White color.
 - 7. Finish of Cabinet Interior: White enamel.
- B. Standard Cabinet Construction:
 - 1. Non-fire-resistance-rated.
 - 2. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- C. Cabinet Configuration: Partially-Recessed.
 - 1. Trim: Flat rolled edge.

2.4 FIRE BLANKET CABINET

- A. Drop-Type Fire Blanket Cabinet
 - 1. Basis of Design: SE3006 as manufactured by Flinn Scientific, Inc.
 - 2. Cabinet:
 - a. Material: Manufacturer standard.
 - b. Mounting: As indicated on Drawings.

2.5 ACCESSORIES

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Locate as indicated on Drawings, as directed by the Owner, and as follows:
 - 1. Provide a minimum of one Multipurpose Fire Extinguisher for each 6,000 sq. ft (557 sq. m), or part thereof, in the project scope, per NFPA 10 Table 6.2.1.1 or as indicated on Drawings, whichever is greater.

2. Provide one Multipurpose Fire Extinguisher with wall bracket in each of the following locations:
 - a. Mechanical Rooms.
 - b. Electrical Rooms.
 - c. MDF/IDF/Telecommunications Rooms.
 - d. Fire Riser Rooms.
 - e. Auditoriums of 4000 square feet or less.
- B. Install in accordance with manufacturer's instructions.
- C. Install cabinets plumb and level in wall openings, such that it complies with accessibility requirements.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets.
- F. Position cabinet signage at _____.

3.3 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide a separate maintenance contract for the service and maintenance of _____ for _____ years from Date of Substantial Completion.

END OF SECTION 10 44 00

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SECTION 10 51 26 - PLASTIC LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic lockers.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 06 10 00 - Rough Carpentry: Wood base construction.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.
- D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Full Size Sample: One full-size locker of each construction specified for evaluation of construction.
- E. Samples: Submit two samples 3 by 6 inches (75 by 150 mm) in size, of each color scheduled.
- F. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Lockers:
 - a. American Specialties, Inc. www.americanspecialties.com/#sle.
 - b. ASI Storage Solutions: www.asi-storage.com/#sle.
 - c. Columbia Lockers, a division of PSiSC: www.psisc.com/#sle.
 - d. List Industries, Inc: www.listindustries.com/#sle.
 - e. Scranton Products: www.scrantonproducts.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 LOCKER APPLICATIONS

- A. Student Lockers: Solid plastic lockers, wall mounted with matching closed base.
 - 1. Width: 15 inches (381 mm).
 - 2. Depth: 18 inches (457 mm).
 - 3. Height: 72 inches (1830 mm).

4. Locker Configuration: Three tier.
5. Fittings: Size and configuration as indicated on drawings.
6. Ventilation: By open space between the back of the door and locker body.
7. Locking: Padlock hasps, for padlocks provided by Owner.
8. Provide sloped top.

2.3 SOLID PLASTIC LOCKERS

- A. Accessibility: Comply with ICC A117.1 and ADA Standards for lockers identified to be accessible.
- B. Lockers: Factory assembled, made of solid plastic panels, homogenous color throughout.
 1. Doors: Full overlay without frame or framed.
 2. Locker Body Construction: Manufacturer's standard for selected product.
 3. Where locker ends or sides are exposed, provide same finish as fronts or provide extra panels to match fronts.
 4. Provide filler strips where indicated, securely attached to lockers.
 5. Door Color: To be selected by Architect; allow for 2 different colors.
 6. Body Color: Manufacturer's standard white or light color.
- C. Component Thicknesses:
 1. Doors: 1/2 inch (13 mm) minimum thickness.
 2. Locker Body: Tops, bottoms, backs, and shelves 3/8 inch (10 mm) minimum.
 3. End Panels and Filler Panels: 1/2 inch (13 mm) minimum thickness.
 4. Sloped Tops: 1/2 inch (13 mm) minimum thickness.
 5. Toe Kick Plates: 1/2 inch (13 mm) minimum thickness.
- D. Hinges: Full height of locker, manufacturer's standard heavy duty type.
- E. Number Plates: Provide rectangular shaped aluminum plates. Form numbers ____ inch (____ mm) high of block font style with ADA designation, in contrasting color.
- F. Locks: Locker manufacturer's standard type indicated above.
- G. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with padlock hasps, for padlocks provided by Owner.
- H. Locker Legs: Manufacturer's standard adjustable support and leveling leg, minimum 1 inch (25 mm) adjustment; with hardware for attaching toe kick plates.
- I. Locker Base: Solid plastic base, 4 inches (102 mm) high, field assembled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases are properly sized.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Install end panels, filler panels, sloped tops, and miscellaneous panels.
- F. Install fittings if not factory installed.
- G. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 26

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SECTION 10 55 00 - POSTAL SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Central mail delivery boxes.
 - 2. Wall-Mounted Mailboxes.
 - 3. Cluster Box Units (CBU).
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Fabricated metal pedestal and anchor bolts for mail box.

1.2 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.
- D. Samples: Submit two sets of manufacturer's available colors.

1.4 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Mailboxes:
 - a. Florence Manufacturing Company: www.florencemailboxes.com.
 - b. Jensen Mailboxes: www.jensenmailboxes.com.
 - c. Postal Products Unlimited, Inc: www.postalproducts.com.
 - d. Salsbury Industries: www.mailboxes.com.
 - e. Security Manufacturing Corp: www.securitymanufacturing.com.

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MAILBOXES

- A. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.
 - 1. Basis of Design Product:
 - a. Products manufactured by Postal Products Unlimited, Inc.
 - 2. Materials: Aluminum with stainless steel hardware.
 - 3. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
 - 4. Unit Types and Sizes: As indicated on Drawings.
 - 5. Configurations: Refer to Drawings for overall dimensions and layouts.
- B. Wall-Mounted Mailboxes: Fully-recessed, complying with 39 CFR 111 (USPS-STD-4C).
 - 1. Basis of Design Product:
 - a. Products manufactured by Postal Products Unlimited, Inc.
- C. Cluster Box Units (CBU): Pedestal-mounted, mail receptacle with weather-resistant cabinet for outdoor installation; front-loading, double-column design.
 - 1. Basis of Design Product:
- D. Components
 - 1. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
 - 2. Latching - Hinged Rear Door Panel: Lock not required, fabricate hinged rear door panel with means of mechanical latching.
 - 3. Pedestals: Standard aluminum pedestal with rubber mounting pad designed to meet USPS and height requirements of ADA Standards.
 - 4. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that concrete base and anchor bolts are ready to receive pedestal-mounted units.
- B. Verify that rough-openings are ready to receive wall-mounted units.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements (where a.

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- B. Adjust and lubricate door hardware to operate properly.
- C. Install mailbox identification items.

END OF SECTION 10 55 00

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SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Four post shelving.
- B. Case type shelving.
- C. Case type cabinets.
- D. Case type desks.
- E. Cantilevered shelving.
- F. Shelving accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and reinforcement in walls for anchoring shelving units.
- B. Section 09 21 16 - Gypsum Board Assemblies: Blocking and reinforcement in walls for anchoring shelving units.
- C. Section 10 56 26 - Mobile Storage Shelving: Installation of metal storage shelving on mobile carriages.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Rated uniform shelf loads.
 - 2. Details of shelving assemblies, including reinforcement.
 - 3. Accessories.
 - 4. Substrate preparation instructions and recommendations.
 - 5. Storage and handling requirements and recommendations.
 - 6. Installation methods.
 - 7. Specimen warranty.
 - 8. Maintenance methods.
- C. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
 - 1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer, licensed in the state of Texas, will be acceptable.
- D. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate methods of achieving specified anchoring requirements.
- E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 77 00 - Closeout Procedures, for additional provisions.
 - 2. Extra Shelves: Two of each size with shelf brackets.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged units.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Four Post Shelving:
 - a. ASI Storage Solutions: www.asi-storage.com.
 - b. Hallowell: www.hallowell-list.com.
 - c. List Industries, Inc: www.listindustries.com/#sle.
 - d. Montel; SmartShelf: www.montel.com/#sle.
 - e. Penco Products, Inc: www.pencoproducts.com/#sle.
 - f. SpaceSaver Corporation: www.spacesaver.com/#sle.
 - g. Tennsco Storage; Z-Line Shelving: www.tennsco.com/#sle.
 - 2. Case Type Shelving:
 - a. ASI Storage Solutions: www.asi-storage.com/#sle.
 - b. List Industries, Inc; Case Shelving: www.listindustries.com/#sle.
 - c. Penco Products, Inc: www.pencoproducts.com/#sle.
 - d. SpaceSaver Corporation: www.spacesaver.com/#sle.
 - e. Tennsco Storage; Q-Line Shelving: www.tennsco.com/#sle.
 - 3. Case Type Shelving Cabinets:
 - a. DeBourgh Manufacturing Co; Industrial Storage Cabinets: www.debourgh.com/#sle.
 - b. List Industries, Inc; Metal Storage Cabinets: www.listindustries.com/#sle.
 - 4. Cantilevered Shelving:
 - a. Montel; Aetnastak: www.montel.com/#sle.
 - b. SpaceSaver Corporation: www.spacesaver.com/#sle.
 - c. Tennsco Storage; Estey Designer Series Library Shelving: www.tennsco.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 SHELVING - GENERAL

- A. Refer to Drawings for layout and sizes.
- B. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
 - 1. Provide hardware of type recommended by manufacturer for substrate.
 - 2. Refer to Drawings for additional details of anchorage.

2.3 FOUR POST SHELVING

- A. Four Post Shelving: Steel post-and-beam or post-and-shelf type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
1. Unit Width: ___ inches (___ mm), center to center of posts.
 2. Shelf Capacity: Uniform distributed load of ___ psf (___ kPa), minimum.
 3. Shelf Beam Capacity: ___ lbs (___ kg) per shelving bay.
 4. Shelf Depth: ___ inches (___ mm), minimum.
 5. Unit Depth: Not more than ___ inch (___ mm) greater than shelf depth.
 6. Clear Shelf Opening Height: ___ inches (___ mm), minimum.
 7. Shelves per Unit: ___.
 8. Unit Height: ___ inches (___ mm), overall, maximum.
 9. Finish: _____.
 - a. Color: Manufacturer's standard gray.
 - b. Color: To be selected by Architect from manufacturer's standard range.
 10. Provide single-face and double-face units where indicated.
 11. Number of Units: As indicated on Drawings.
- B. Posts: Formed sheet members; perforations exposed on face of members are not acceptable.
1. Metal Thickness: ___ gauge, ___ inch (___ mm).
 2. Post Shape: _____ intermediate posts, _____ end posts forming corners.
 3. Post Face Width: ___ inches (___ mm), maximum.
 4. Connecting Hardware: _____.
 5. Post Bases: Flat steel foot plate.
- C. Bracing: Formed sheet members.
1. Back Sway Bracing: _____; at back of each unit.
 2. Side Sway Bracing: _____; at each side of each unit.
 3. Refer to Drawings for additional details of bracing.
- D. Shelves: Formed sheet, finished on all surfaces.
1. Metal Thickness: ___ gauge, ___ inch (___ mm).
 2. Shelf Edge Profile: Extending ___ inch (___ mm), maximum, below top surface of shelf.
 3. Provide raised edge lip on _____; height ___ inches (___ mm).
 4. Shelf Connection to Posts: _____.

2.4 CASE TYPE SHELVING, CABINETS, AND DESKS

- A. Case Type Shelving: Steel, closed sides and backs, with shelving brackets, shelving surfaces, and accessories as specified.
1. Unit Width: ___ inches (___ mm), overall.
 2. Shelf Capacity: Uniform distributed load of ___ psf (___ kPa), minimum.
 3. Shelf Deflection: L/140, maximum, under specified uniform load.
 4. Shelf Depth: ___ inches (___ mm), minimum.
 5. Unit Depth: Not more than ___ inch (___ mm) greater than shelf depth.
 6. Clear Shelf Opening Height: ___ inches (___ mm), minimum.
 7. Shelves per Unit: ___.
 8. Unit Height: ___ inches (___ mm), overall, maximum.
 9. Finish: _____.
 10. Provide single-face and double-face units where indicated.
 11. Number of Units: As indicated on Drawings.
- B. Case Construction: Formed sheet metal comprising vertical support members and enclosure panels.
1. Shelf Support Members: ___ gauge, ___ inch (___ mm), minimum; manufacturer's standard profile.

2. Face Width of Exposed Vertical Supports: __ inches (__ mm), maximum.
 3. Panels: __ gauge, __ inch (__ mm), minimum.
 4. Provide panels at intermediate divisions as well as ends.
 5. Provide canopy tops of same construction as shelves.
 6. Connecting Hardware: _____.
 7. Post Bases: Flat steel foot plate.
- C. Shelves: Formed sheet metal, finished on all surfaces.
1. Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Shelf Edge Profile: Extending __ inch (__ mm), maximum, below top surface of shelf.
 3. Provide raised edge lip on _____; height __ inches (__ mm).
 4. Shelf Connection to Posts: _____.
- D. Desk Top: Steel, sloped writing surface, four compartment organizer, cylinder locking drawer on steel ball bearing slides.
1. Writing Surface: _____ inches by _____ inches (_____ mm by _____ mm).
 2. Mounting: _____.
- E. Cabinet Doors: Manufacturer's standard welded steel.
1. Style: _____.
 2. Hinges: _____.
 3. Handles: _____, _____.
 4. Pulls: _____.
 5. Locks: _____.

2.5 CANTILEVERED SHELVING

- A. Cantilevered Shelving: Freestanding formed steel post frame with slots for cantilevered shelving brackets, shelving brackets, shelving surfaces, and accessories as specified.
1. Unit Width: __ inches (__ mm), center to center of posts.
 2. Shelf Capacity: Uniform distributed load of __ psf (__ kPa), minimum.
 3. Shelf Deflection: L/140, maximum, under specified uniform load.
 4. Adjustability of Shelving: At intervals of __ inches (__ mm) on center, minimum.
 5. Shelf Depth: __ inches (__ mm), minimum.
 6. Unit Depth: Not more than __ inch (__ mm) greater than shelf depth.
 7. Clear Shelf Opening Height: __ inches (__ mm), minimum.
 8. Shelves per Unit: As indicated on drawings.
 9. Unit Height: __ inches (__ mm), overall , maximum.
 10. Finish: _____.
 11. Provide single-face and double-face units where indicated.
 12. Number of Units: As indicated on Drawings.
- B. Frame: Formed steel members comprising posts, horizontal spreaders at top and bottom, and base brackets resisting overturning; frame configuration providing full face height and width available for adjustable shelves.
1. Sheet Metal Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Base Brackets Height from Floor: __ inches (__ mm), maximum.
 3. Connecting Hardware: _____.
 4. Provide manufacturer's standard adjustable leveling devices.
- C. Shelf Brackets: Combination shelf support and bookend, formed steel; full depth of shelves and minimum __ inches (__ mm) height above shelf surface; rounded outer edges and corners for safety.
1. Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Profile: Sloped _____ degrees from back to front.
 3. Connection to Posts: _____.

- D. Shelves: Formed steel, finished on all surfaces.
 - 1. Thickness: __ gauge, __ inch (__ mm), minimum.
 - 2. Bottom Shelf Edge Profile: __ inch (__ mm) with integral kickplate.
 - 3. Upper Shelves Edge Profile: Extending __ inch (__ mm), maximum, below top surface of shelf.
 - 4. Provide raised edge lip on _____; height __ inches (__ mm).
 - 5. Shelf Connections: _____.
 - 6. Provide canopy tops of same construction as adjustable shelves.
- E. End Panels: Formed steel, finished on all surfaces.
 - 1. Thickness: __ gauge, __ inch (__ mm), minimum.
 - 2. Panel Faces: Flush, flat, without oil-canning.
 - 3. Provide end panels on all exposed ends of shelving runs.

2.6 ACCESSORIES

- A. Kick Plates: Formed sheet metal; enclose open space between bottom shelf and floor on all front sides and open ends; finished to match.
- B. Drawers: Formed steel, with mounting brackets.
 - 1. Width: __ inch (__ mm).
 - 2. Height: __ inch (__ mm).
 - 3. Depth: Shelf depth.
 - 4. Finish: _____.
- C. Shelf Partitions: _____, _____.
 - 1. Height: __ inches (__ mm).
 - 2. Finish: _____.
 - 3. Mounting: _____.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.
- C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch (3 mm) difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.4 CLEANING

- A. Clean shelving and surrounding area after installation.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 10 56 13

SECTION 10 56 17 - WALL-MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shelves.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 06 20 00 - Finish Carpentry: Wood shelves.
- C. Section 09 21 16 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 77 00 - Closeout Procedures for additional provisions.
 - 2. Extra Brackets: ____ of each size of standard straight bracket.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Shelving:

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 COMPONENTS

A. Shelves:

- B. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
B. Mount standards or brackets to solid backing capable of supporting intended loads.
C. Install brackets, shelving, and accessories.
D. Provide double sided foam tape between adjoining sections of aluminum shelving to maintain alignment.

3.4 PROTECTION

- A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 56 17

SECTION 10 73 16.13 - METAL CANOPIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Accessories necessary for a complete application.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings.

1.3 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022, with Errata (2025).
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- D. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- E. ASTM E2950 - Standard Specification for Metal Canopy Systems; 2014 (Reapproved 2020).
- F. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2024.
- G. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- H. {RSTEMP#undefined}
- I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.
- D. Design Data: Submit comprehensive structural analysis of design for the specified loads indicated on the Structural Drawings. Stamp and sign calculations and drawings by professional engineer licensed in the State in which the Project is located.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement.
- G. Erector's Qualification Statement.
- H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

- I. Wind load testing for decking.
- J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
 - 1. Submit signed and sealed design calculations and reviewed shop and erection drawings with signed and sealed shop drawings.
 - 2. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 303.
 - 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
- D. Erector Qualifications: Company specializing in performing the work of this section.
 - 1. Not less than three years of documented experience and approved by canopy manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 SHOP FABRICATED _____

- A. Basis of Design:
- B. Pre-engineered system complying with ASTM E2950.
- C. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
 - 1. Loads: As indicated on Structural Drawings.

- D. Thermal Movement: Design system to accommodate thermal movement caused by ambient temperature range of 120 degrees F (49 degrees C) and surface temperature range of 180 degrees F (82 degrees C) without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- E. Configuration: As indicated on Drawings.

2.3 COMPONENTS

- A. Concrete Footings: Refer to Structural for additional requirements.

2.4 SHOP FABRICATION

- A. Provide a complete system ready for erection at project site.
- B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- C. Perform welding in accordance with AWS D1.1/D1.1M.
- D. Fabricate connections for bolt, nut, and washer connectors.

2.5 FINISHES

2.6 ACCESSORIES

- A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4 inch (19 mm) diameter.
- B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as metal decking; factory-fabricated to required profiles.
 - 1. Exposed Fasteners: Not permitted.
- C. Grout: ASTM C1107/C1107M; non-shrinking; premixed compound consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents.
- D. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that foundation, electrical utilities, and placed anchors are in correct position.
- C. Verify that bearing surfaces are ready to receive this work.
- D. Do not proceed with installation until all conditions are satisfactory.

3.2 INSTALLATION - FRAMING

- A. Erect framing in accordance with AISC 303.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation.
- C. Fasten columns to anchor bolts.
- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 INSTALLATION - CANOPY COVERING

- A. Install in accordance with requirements of test report for wind load tested assembly.
- B. Fasten metal decking to steel support members, aligned level and plumb.
- C. Install fascia panels, trim, and flashing.
- D. Separate dissimilar metals using concealed bituminous paint.
- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.4 TOLERANCES

- A. Maximum Variation from Level: Plus/Minus 1/8 inch (3.175 mm).

3.5 CLEANING

- A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.6 PROTECTION

- A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION 10 73 16.13

SECTION 10 75 00 - FLAGPOLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric operation.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete base and foundation construction.
 - 2. Division 26 - Electrical: Conduit, cable, outlet boxes, and disconnect.
 - 3. Division 26 - Electrical: Electrical characteristics and wiring connections.
 - 4. Section 31 23 23 - Fill: Sand to fill foundation tube sleeve.

1.3 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- B. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.
- C. NEMA MG 00001 - Motors and Generators; 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
- D. Samples: Submit two _____, ____ by ____ inch (____ by ____ mm) in size, illustrating pole material, color, and finish.
- E. Designer's Qualification Statement.
- F. Operation Data: Provide operating data for the controller and timer.
- G. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules and _____.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Texas.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Flagpoles:
 - a. Concord American Flagpole: www.concordamericanflagpole.com.
 - b. Morgan-Francis Flagpoles & Accessories: www.morgan-francis.com.
 - c. Pole-Tech Co, Inc: www.poletech.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 FLAGPOLES

- A. Basis of Design Product:
 - 1. Internal - Independence manufactured by Concord American Flagpole.
- B. Flagpoles: Designed in accordance with NAAMM FP 1001
 - 1. Material: _____.
 - 2. Design: _____.
 - 3. Mounting: _____.
 - 4. Outside Butt Diameter: ____ inches (____ mm).
 - 5. Outside Tip Diameter: ____ inches (____ mm).
 - 6. Nominal Wall Thickness: ____ inches (____ mm).
 - 7. Nominal Height: 10 feet (3 m), 20 feet (6 m), 25 feet (7.62 m), 30 feet (9.1 m), 35 feet (10.7 m), 40 feet (12.2 m), 50 feet (15.2 m), or ____ feet (____ m), as indicated on Drawings; measured from nominal ground elevation.
 - 8. Halyard: External type, electric operation.
- C. Performance Requirements:
 - 1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to ____ miles/hr (____ km/hr) wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.3 POLE MATERIALS

- A. Steel: ASTM A53/A53M Type S, Grade B.

2.4 ACCESSORIES

- A. Finial Ball: _____, ____ inch (____ mm) diameter.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Flag(s): _____ fabric, _____ grommets, hemmed edges.
 - 1. Size(s):
 - a. For 10 foot (3.0 m) Pole(s): 3 ft by 5 ft (0.9 m by 1.5 m).
 - b. For 20 foot (6.1 m) Pole(s): 4 ft by 6 ft (1.2 m by 1.8 m).
 - c. For 25 foot (7.6 m) Pole(s): 4 ft by 6 ft (1.2 m by 1.8 m).
 - d. For 30 foot (9.1 m) Pole(s): 5 ft by 8 ft (1.5 m by 2.4 m).
 - e. For 35 foot (10.7 m) Pole(s): 6 ft by 10 ft (1.8 m by 3.0 m).
 - f. For 40 foot (12.2 m) Pole(s): 6 ft by 10 ft (1.8 m by 3.0 m).
 - g. For 50 foot (15.2 m) Pole(s): 10 ft by 15 ft (3.0 m by 4.6 m).
 - h. For ____ foot (____ m) Pole(s): ____ ft by ____ ft (____ m by ____ m).
- D. Cleats: ____ inch (____ mm) size, aluminum with galvanized steel fastenings, two per halyard.
- E. Halyard: ____ inch (____ mm) diameter _____.

- F. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.
- G. Counterbalance: _____.
- H. Primer: Zinc chromate type.

2.5 OPERATORS

- A. Electric Winch: Portable type, as follows:
 - 1. Speed: ____ ft/min (____ m/min).
 - 2. ____ hp (____ kW).
 - 3. ____ kW.
 - 4. ____ rated load amperes.
 - 5. ____ volts, single phase, 60 Hz.
 - 6. ____ amperes maximum fuse size.
 - 7. ____ percent minimum power factor at rated load.
 - 8. See Section 26 05 83 for additional requirements.
- B. Motor: NEMA MG 1
- C. Controls: _____.
- D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.6 MOUNTING COMPONENTS

- A. Lighting Ground Rod: ____ inch (____ mm) long copper rod, 3/4 inch (19 mm) diameter.
- B. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.7 FINISHING

- A. Metal Surfaces in Contact With Concrete: _____.
- B. Final: _____ finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

- A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- B. Refer to Section _____ for placement of anchor devices and foundation sleeve.
- C. Refer to Section _____ for placement and wire connection of control operator.
- D. Electrically ground flagpole installation.
- E. Fill foundation tube sleeve with concrete specified in Section 03 30 00.
- F. Fill foundation tube sleeve with sand specified in Section 31 23 23 and compact.
- G. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.
- H. Set brackets for wall set flagpoles anchored securely into wall construction. Seal watertight.
- I. Locate electric control box where indicated.

- J. Coordinate installation of conduit and boxes from disconnect to control unit and control unit to motor operating device.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch (25 mm).

3.5 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION 10 75 00

SECTION 10 81 13 - BIRD CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bird spike passive bird control products.
 - 2. Accessories as needed for a complete installation.
- B. Related Sections:
 - 1. Section 06 20 00 - Finish Carpentry.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

1.4 SUBMITTALS

- A. Product Data: All product information available from manufacturer.
- B. Samples: Two (2) of specified bird control model or models, not less than six (6) in length.
- C. Manufacturer's installation instructions and drawings.

1.5 QUALITY ASSURANCE

- A. Installers must obtain and review all product information relating to the installation of the specified bird control.
- B. Installers must be completely familiar with the installation procedures of the specified bird control model or models before starting work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Bird Control Strips:
 - a. Bird Barrier America, Inc.: www.bir.
 - b. Bird B Gone, LLC.: www.birdbgone.com.
 - c. Nixalite of America, Inc.: www.nixalie.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 BASIS OF DESIGN

- A. Specifications are based on product(s) indicated as Basis of Design.

2.3 BIRD CONTROL STRIPS

- A. Basis of Design Product(s):
 - 1. Dura-Spoke manufactured by Bird Barrier America, Inc.
 - 2. Bird B Gone Bird Spikes - Stainless Steel manufactured by Bird B Gone, LLC.
 - 3. Premium Model H, S, or W (as appropriate for installation) manufactured by Nixalite of America.
- B. Strips:

1. Type: Architectural bird control strips. specified mounting hardware system.
 2. Material: Flexible, ASTM A666 316 stainless steel construction.
 3. Dimensions: 4 inches high, standard with, 120 wires per 12 inches.
 4. Lengths: Longest practical length up to 48 inches.
- C. Finish: Natural stainless steel finish.
- D. Mounting System: Stainless Steel mounting clips and hardware recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Ensure surfaces are ready for installation. Do not proceed until all unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean all installation surfaces thoroughly. Remove all bird droppings and related refuse. Remove all closely overhanging foliage, if any. Surface must be clean and dry before installation.

3.3 INSTALLATION

- A. Install architectural bird control in accordance with manufactures written installation procedures.
- B. Cover the entire specified installation surface, not just the outer edges. Bird control strips must follow all angles and contours closely. Cut strips where necessary to fit the surface properly. Gaps in the bird control coverage not permitted.
- C. Fasten bird control strips to the surface with the mounting hardware recommended by the manufacturer.
- D. Inspect finished installation and make adjustments as necessary to conform to manufacturer's recommendations.

3.4 CLEANING

- A. Remove debris and waste materials from project site.

END OF SECTION 10 81 13

SECTION 10 82 13 - EXTERIOR GRILLES AND SCREENS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior aluminum grilles and screens attached to structure.
- B. Framed exterior polycarbonate mesh screens to be mounted on structure provided by others.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting substrates.
- B. Section 04 20 00 - Unit Masonry: Mounting substrates.
- C. Section 05 12 00 - Structural Steel Framing: Mounting substrates.
- D. Section 07 42 13 - Metal Wall Panels: Mounting substrates.
- E. Section 08 43 13 - Aluminum-Framed Storefronts: Mounting substrates.
- F. Section 08 44 13 - Glazed Aluminum Curtain Walls: Mounting substrates.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2020, with Errata (2022).
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- G. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- L. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- M. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2024).
- N. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
- O. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2022.

- P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- Q. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2024.
- R. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- S. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.
- T. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Submit detailed shop drawings, indicating component profiles, sections, finishes, fastening details, special details, and manufacturer's technical and descriptive data.
 - 1. Include field dimensions of openings and elevations on shop drawings.
 - 2. Indicate distinction between factory-assembled and field-assembled work on shop drawings.
- C. Samples: Submit samples for color verification, 10 inches (254 mm) by 10 inches (254 mm) minimum.
- D. Samples: Submit assembled sample 24 inches by 24 inches (610 mm by 610 mm) minimum size to illustrate design, fabrication techniques, workmanship, and finish color.
- E. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
- F. Designer's Qualification Statement.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Perform structural design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original, unopened packaging, with labels clearly identifying manufacturer and material.
- B. Store materials indoors, protected from moisture, humidity, and extreme temperature fluctuations.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a one year period after Date of Substantial Completion.

- C. Finish Warranty: Provide manufacturer's ten year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Exterior Aluminum Grilles and Screens:
1. Architectural Grilles & Sunshades, Inc; _____: www.agsshade.com/#sle.
 2. Construction Specialties, Inc; Geometric Grilles: www.c-sgroup.com/#sle.
 3. DAMS Incorporated; TU Series: www.damsinc.com/#sle.
 4. Industrial Louvers, Inc; _____: www.industriallouvers.com/#sle.
 5. Metalwerks; Screenwalls: www.metalwerksusa.com/#sle.
 6. Nelson Industrial, Inc; _____: www.nelsonii.com/arch/#sle.
 7. Ruskin Company; _____: www.ruskin.com/#sle.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Exterior Polycarbonate Mesh Screens:
1. Kaynemaile Ltd; _____: www.kaynemaile.com/#sle.
 2. _____.
 3. _____.
 4. _____.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 GRILLES

- A. Aluminum Grilles: Provide shop fabricated, shop finished grilles assembled into panels.
1. Grill Type: Flat bar/egg crate.
 - a. Bar Angle: As selected by Architect.
 - b. Horizontal Bar Spacing: _____ inch (_____ mm) on center.
 - c. Vertical Bar Spacing: _____ inch (_____ mm) on center.
 - d. Panel Depth: _____ inch (_____ mm) deep.
 2. Grille Type: Tubular shape.
 - a. Pattern: _____.
 - b. Panel Depth: _____ inch (_____ mm).
 3. Panel Size and Configuration: As indicated on drawings.
 4. Frame/Support: Extruded aluminum tube or flat aluminum bar.
 5. Wind Load Resistance: Design to resist positive and negative wind load, _____ psf (_____ kPa), without damage or permanent deformation.

2.3 SCREENS

- A. Aluminum Screens: Provide shop fabricated, shop finished screens assembled into panels.
1. Screen Type: Perforated metal sheet.
 - a. Hole Size and Spacing: _____ inch (_____ mm) diameter, _____ inch (_____ mm) apart.
 - b. Hole Shape: _____.
 - c. Panel Depth: _____ inch (_____ mm) deep.
 2. Screen Type: Laser-cut metal sheet.
 - a. Pattern: _____.
 - b. Panel Depth: _____ inch (_____ mm).
 3. Panel Size and Configuration: As indicated on drawings.
 4. Frame/Support: Extruded aluminum tube or flat aluminum bar.
 5. Wind Load Resistance: Design to resist positive and negative wind load, _____ psf (_____ kPa), without damage or permanent deformation.
- B. Polycarbonate Mesh Screens: Provide shop or field fabricated, vertically tensioned polycarbonate mesh panels attached to subframes.

1. Mesh Panel Framing: Manufacturer's standard extruded aluminum side tracks and top and bottom stainless steel tubes.
2. Subframe: Steel angle to fully frame mesh panel system, 3-1/4 inch by 3-1/4 inch (80 mm by 80 mm) minimum, provided by others.
3. Mesh Characteristics:
 - a. Physical Open Area: 80 percent.
 - b. Visual Open Area: 25 percent.
 - c. Mesh Ring Diameter: 7/8 inch (22 mm) internal diameter; 1-1/8 inch (28 mm) external diameter.
 - d. Mesh Screen Thickness: 5/8 inch (15 mm).
 - e. Mesh Color: As selected by Architect from manufacturer's standard range.
 - f. Mesh Color: As indicated on drawings.
4. Configuration: As indicated on drawings.
5. Sizes: As indicated on drawings.
6. Design Criteria: Design and fabricate to resist the following loads without failure, damage, or permanent deflection:
 - a. Wind: ____ psf (____ kPa) positive, ____ psf (____ kPa) negative; minimum
 - b. Snow: ____ psf (____ kPa); minimum.
 - c. Live: ____ psf (____ kPa); minimum.
7. Fire Performance:
 - a. Flame Spread Index (FSI): Class A, 0 to 25, when tested in accordance with ASTM E84.
 - b. Smoke Developed Index (SDI): 350 or less, when tested in accordance with ASTM E84.
 - c. Flammability: Pass, when tested in accordance with NFPA 701.
 - d. Flammability: Class HB-CC1; Self-extinguishing when tested in accordance with ASTM D635.
 - e. Fire Performance: Tested in accordance with, and complying with the acceptance criteria of NFPA 285.
 - f. Smoke Density: 70.9 percent maximum when tested in accordance with ASTM D2843.
 - g. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
 - h. Self-Ignition Temperature: Greater than 968 degrees F (520 degrees C), when tested in accordance with ASTM D1929.
 - i. Flash-Ignition Temperature: Greater than 842 degrees F (450 degrees C), when tested in accordance with ASTM D1929.
8. Products:
 - a. Kaynemaile Ltd; Kaynemaile Exterior Screens: www.kaynemaile.com/#sle.
 - b. _____.
 - c. _____.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M) alloy 6063, temper T5, 1/8 inch (3 mm) minimum wall thickness.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M) alloy 5005, with temper as required for forming.
- C. Aluminum Coated Steel Sheet: ASTM A792/A792M.
- D. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.
- E. Stainless Steel Tensioning Tubes: ASTM A276/A276M.

2.5 FABRICATION

- A. Shop fabricate grilles and screens to the greatest extent possible.
- B. Disassemble as necessary for shipping and handling, clearly mark units for proper reassembly.
- C. Provide supports, anchorages, and accessories as required for complete assembled system.
- D. Provide inserts as required for installation into concrete or masonry based support materials.
- E. Fabricate grilles to ensure proper fit into openings of sizes indicated, with tolerances for installation.
- F. Attach grille panels to each other by welding, unless otherwise indicated.

2.6 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- C. Natural Anodized Finish with Organic Seal: AAMA 612 Clear anodic coating with non-aqueous electro-deposited organic seal; not less than 0.7 mils (0.018 mm) thick.
- D. Color Anodized Finish with Organic Seal: AAMA 612 Electrolytically deposited colored anodic coating with non-aqueous electro-deposited organic seal; not less than 0.7 mils (0.018 mm).
- E. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
- F. Superior Performing Organic Coatings: AAMA 2605; multiple coats, thermally cured polyvinylidene fluoride system.
- G. Finish Color: As indicated on drawings.
- H. Finish Color: As selected by Architect from manufacturer's standard color range.

2.7 ACCESSORIES

- A. Fasteners: ASTM F593 stainless steel or ASTM A307 carbon steel, sizes to suit installation conditions.
- B. Anchors and Inserts: Corrosion resistant; type, size, and material required for loading and installation as indicated.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that painting, roofing, masonry work, and other adjacent work that might damage grille finish have been completed prior to start of installation.
- C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's written installation instructions.
- B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint, and allow paint to dry prior to installation of aluminum components.
- C. Set grilles level, plumb, with uniform joints, and in alignment with adjacent work as indicated.
- D. Mechanically secure grilles to supporting structure.

- E. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch (3 mm).
- B. Maximum Offset From True Alignment: 1/8 inch (3 mm).

3.4 CLEANING

- A. Remove temporary protective covering as grilles are installed.
- B. Clean finished surfaces as recommended by manufacturer and maintain clean condition until Date of Substantial Completion.
- C. Touch-up damaged finish coating using material provided by manufacturer to match original coating.
- D. Replace grilles that have been damaged beyond touch-up repair.

3.5 PROTECTION

- A. Protect installed grilles to ensure grilles are without damage until Date of Substantial Completion.

END OF SECTION 10 82 13

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Kitchen appliances.
 - 2. Laundry appliances.
- B. Related Sections:
 - 1. Division 22 - Plumbing: Plumbing connections for appliances.
 - 2. Division 23 - Mechanical: Exhaust connections for appliances.
 - 3. Division 26 - Electrical: Electrical connections for appliances.

1.2 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).
- C. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).

1.5 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.
- D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 KITCHEN APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refrigerator: Free-standing, side-by-side, and frost-free.
 - 1. Capacity: Total minimum storage of 18 cubic ft (0.51 cu m); minimum 15 percent freezer capacity.

2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
3. Features: Include glass shelves, automatic icemaker, light in freezer compartment, and in-door water and ice dispenser.
4. Exterior Finish: Porcelain enameled steel, color as selected by Architect from manufacturer's full line.

2.3 LAUNDRY APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Clothes Washer: Top-loading stationary.
 1. Basis of Design: WM6700HBA manufactured by LG.
 2. Size: Large capacity.
 3. Controls: Solid state electronic.
 4. Cycles: Include normal, permanent press, delicate, soak, and automatic soak.
 5. Motor Speed: Single-speed.
 6. Features: Include optional second rinse, bleach dispenser, fabric softener dispenser, self-cleaning lint filter, sound insulation, and end of cycle signal.
 7. Pedestal: Provide WDP6B as manufactured by LG.
 8. Finish: Painted steel, color black.
- C. Clothes Dryer: Electric, stationary.
 1. Basis of Design: DLHC5502 manufactured by LG.
 2. Size: Large capacity.
 3. Controls: Solid state electronic, with electronic moisture-sensing dry control.
 4. Temperature Selections: One.
 5. Cycles: Include normal, permanent press, knit/delicate, and air only.
 6. Features: Include interior light, reversible door, stationary rack, sound insulation, and end of cycle signal.
 7. Pedestal: Provide WDP6B as manufactured by LG.
 8. Finish: Painted steel, color black.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.3 ADJUSTING

- A. Adjust equipment to provide efficient operation.

3.4 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION 11 30 13

SECTION 11 46 83 - ICE MACHINES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Commercial ice machines
 - 2. Appliance coordination including service connections, supply lines, and power
 - 3. Accessories necessary for a complete installation
- B. Related Sections:
 - 1. Division 22: Domestic water supply.
 - 2. Division 26: Electrical connection.

1.3 SUBMITTALS

- A. Product Data: Technical data including product specifications, installation, and maintenance instructions.
- B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.
- C. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
 - 3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
 - 4. Accessibility Requirements: Comply with applicable requirements.
 - a. United States Access Board Americans with Disabilities Act Accessibility Guidelines (ADAAG) (2010 ADA Standards for Accessible Design).
 - b. ICC A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (2012 TAS).
- B. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- C. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.
- D. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

- A. Warranties: Written warranty signed by manufacturer in which manufacturer of the specific appliance specified agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.
 - 1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer warrants residential units in a commercial application and only with Architect's approval.
- B. Ice maker, Sealed System: Full warranty, including parts and labor, for onsite service on the product.
 - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.2 APPLIANCES

- A. Freestanding Ice Machine and Ice Bin:
 - 1. Basis of Design: Model: F-330BAJ Ice Maker manufactured by Grainger
 - 2. Finish: Stainless Steel.
 - 3. Ice Production: Minimum 525 pounds (2383 kg) with 536 lb (244 kg) ice bin storage
 - 4. Refrigerant: R404A.
 - 5. Electrical: UL listed, 115V, 60 Hz, 1 phase; 8 amp; provide minimum 7 foot cord and NEMA 5-15 plug with each ice maker.
 - 6. Cube Type: Flake.
 - 7. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.
 - 8. Accessories: Ice scoop and related accessories necessary for a complete installation and use.
- B. Appliances, Equipment, and Fixtures: Coordinate equipment, fixtures, appliances regardless which party provides or furnishes. Ensure adequate power supply and properly locate plumbing lines and hook ups, water and drain connections and accessories.
- C. Accessories: Provide accessories necessary for a working installation.

2.3 FINISHES

- A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Stainless Steel Finish: Provide appliances with standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless steel surfaces for uniform, directionally textured finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
 - 1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
 - 2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.

3. Examine space to receive items and verify the space is of sufficient size and configuration for items.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.
- B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.
- E. Connections and Hook ups: Coordinate location of services.
 1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
 2. Wiring: Connect wiring in accordance with manufacturer recommendations.
 3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After installation, start units to confirm proper operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 CLEANING

- A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.5 PROTECTION

- A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

3.6 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 11 46 83

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SECTION 11 53 00 - LABORATORY EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of Contractor-furnished (CFCI) equipment.
- B. Coordination with Owner-furnished Owner-installed (OFOI) equipment.

1.2 RELATED REQUIREMENTS

1.3 REFERENCES

- A. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

1.4 REFERENCE STANDARDS

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.6 SUBMITTALS

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; point loads.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, installation and servicing clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, 6 x6 inches in size illustrating color and finish.
- E. Operation Data: Include description of equipment operation and required adjusting and testing .
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.

- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sterilizers and Glassware Washers:
 - 1. Labconco Corporation: www.labconco.com/#sle.
 - 2. _____.

2.2 EQUIPMENT

- A. Each item energized by a single switch.

2.3 STERILIZERS

- A. Type ____, Sterilizer: (CFCI) Medium scientific sterilizer.
 - 1. Basis of Design: Model _____, as specified herein and manufactured by _____.
 - 2. General: High-performance sterilizer (autoclave) specifically designed for sterilizing or decontaminating laboratory items of many sizes and types, with programmable treatment options.
 - a. UL listed and/or approved electrical devices and components, bearing NEMA MG 00001, IEC or other recognized International ratings, as appropriate for the use intended. Low-voltage DC outputs external to the electrical box.
 - 3. Cabinet Enclosure: Yes.
 - 4. Mounting: On floor, free-standing.
 - 5. Chamber Interior Dimensions: 26 inches wide by 26 inches high by 39 inches front-to-back (660 mm wide by 660 mm high by 991 mm front-to-back).
 - 6. Bio-seal: No.
 - 7. Operating Weight: _____ pounds (_____ kg).
 - 8. Doors: Number, type, and construction indicated.
 - a. Number of Doors: One.
 - b. Hinged, manual-type.
 - c. Gaskets: Manufacturer's standard for type door specified, manufactured to withstand temperatures and pressures generated.
 - d. Provide FDA-approved silicone door seal.
 - 9. Operator Controls: Digital type, with touch screen controls and multi-level menus.
 - a. Reprogrammable cycle configurations.
 - b. Continuous cycle monitoring and control.
 - c. Continuous service diagnostics.
 - d. Virtual Keypad: Allowing operator to easily control all programmable equipment functions, access all equipment monitoring functions, and operate the equipment. At a minimum, allowing the following functionality:
 - 1) Selecting a Program.
 - 2) Presetting main parameters, including sterilization temperature and time, dry time, and set real time clock.
 - 3) Starting a cycle.
 - 4) Stopping a cycle.

- e. Status Indication: Showing status of critical equipment operation. At a minimum, provide indicators for:
 - 1) Start: Indicating required temperature is available for unit operation.
 - 2) Heat: Indicating unit is in the heating stage.
 - 3) Steam: Indicating unit is in the timed sterilization stage.
 - 4) Exhaust: Indicating unit is in the exhaust stage.
 - 5) Drying: Indicating unit is in the drying stage.
 - 6) Fail: Indicating system has failed as a result of protective cut-off or because Stop button has been pressed. Failure message appearing on display.
 - 7) Door Closed: Indicating door is properly closed.
- f. Printer: 24 character (minimum) per line printer integrated into control panel.
 - 1) Functionality: Hard-copy printout of all relevant information concerning operation during each cycle including temperature, pressure, vacuum, sterilization and drying time, number of cycles, etc. For uncompleted cycle(s), a printout indicating cycle failure and cause of cycle failure.
- g. Non-operating end (NOE) control panel.
 - 1) Double-door Sterilizers Only: A touch-sensitive screen similar to the operating end screen. Ability to start preprogrammed cycles. Display concurrently showing the same information as the operating end screen display.
- 10. Control and Monitoring System: Controller, gauges, and wiring.
 - a. Controller: Microcomputer based controller monitoring and controlling all aspects of equipment cycle and process operations. Provide battery backup of microprocessor memory. Controller to ensure fully automatic operation through all equipment cycles.
 - b. Jacket and chamber pressure gauges.
 - c. Chamber capillary temperature gauge.
- 11. Operations Programming: Sterilizer designed to operate a minimum of 12 sterilization programs and 2 test programs as follows:
 - a. Unwrapped Instruments: 4 programs.
 - b. Wrapped Instruments: 4 programs.
 - c. Liquids: 4 programs.
 - d. _____.
 - e. Vacuum Test: For testing integrity of pressure vessel and piping system.
 - f. "Bowie-Dick Test": For testing efficacy of sterilization process.
- 12. Cycle Descriptions: Type included, as indicated.
 - a. Vacuum Cycle: Air and condensate removed from the chamber and load by pulling vacuum during load conditioning and again during drying. Temperature range 230 to 280 degrees F (110 to 138 degrees C). Required.
 - b. Gravity Cycle: Chamber air purged with flowing steam. Air drawn into chamber through bacteria retentive filter during drying phase. Temperature range 230 to 280 degrees F (110 to 138 degrees C). Required.
 - c. Liquid Cycle: Designed to sterilize liquids in open flasks or containers with positive self-venting closures. Similar to gravity cycle except dry phase cannot be selected, and slow exhaust provided after sterilizing phase. Temperature range 230 to 280 degrees F (110 to 138 degrees C). Required.
 - d. Flash Cycle: Designed to flash sterilize instruments in an Operating Room setting for 3 to 10 minutes at 275 degrees F (135 degrees C). Not Required.
 - e. Isothermal Cycle: Flexible low temperature cycle for pasteurization, inspissation, or fractional sterilization. Temperature range 170 to 280 degrees F (76 to 138 degrees C). Not Required.
 - f. Streaming Steam Cycle: Non-flexible low temperature sanitation cycle set at 220 degrees F (105 degrees C) used for melting Agar, and for pasteurization. Not Required.

- g. Effluent Decontamination Cycle: After normal cycle condensate and other liquid effluent produced during processing cycle is automatically decontaminated prior to discharge to floor drain. Not Required.
- 13. Personnel Safety: Design units to integrate personnel safety features typical to the industry including, but not limited to:
 - a. Door operation limiters preventing operator from opening door(s) when unsafe conditions are present.
 - 1) When chamber is pressurized.
 - 2) When a liquid load is at an elevated temperature.
 - b. Safety Sensor: Retracting door if obstruction is detected in the doorway.
 - c. International symbology warning and caution pictographs as appropriate to equipment design.
 - d. Effective design, insulation and fabrication preventing hot surfaces on the exterior of the unit.
- 14. Pressure Vessel: Rectangular design, horizontally mounted with internal corners longitudinally radiused and polished, with welds ground smooth and polished, and comply with ASME BPVC.
 - a. Material: Type 316L stainless steel.
 - b. Pressure Rating: 45 psig (310.3 kPa).
 - c. Vessel Identification: One permanently fixed plate stamped in accordance with ASME codes.
 - d. Baffles: Chamber with Type 316L stainless steel steam inlet baffles designed to direct condensate toward chamber floor, preventing wetting of load, and effecting proper steam and temperature distribution.
 - e. Chamber Ports: Two capped ports for validation and temperature distribution and heat mapping.
- 15. Pressure Vessel Jacket: Enclosing pressure vessel.
 - a. Material: Type 304L stainless steel.
 - b. Pressure Rating: 45 psig (310.3 kPa).
 - c. Monitoring: Provide pressure transducer and gauge to monitor jacket pressure.
 - d. Cooling: Jacket isolation and dumping of jacket steam occurring at the end of all liquid cycles to facilitate optimal solution cooling.
- 16. Chamber and Door Insulation: Manufacturer's standard, fully enclosed.
- 17. Sterilization Chamber Mounting Frame: Type 304L stainless steel frame with height adjustable leveling bolts for support of sterilizing chamber, piping and cabinet.
- 18. Type of Piping: Materials and configurations indicated.
 - a. Chamber: Stainless steel piping.
 - 1) Type 316L stainless steel threaded pipe, unions, gauges and valves: from steam-to-steam generator to chamber.
 - 2) Type 316L stainless steel threaded pipe: from soft water source to steam generator.
 - b. Jacket: Copper and brass piping.
- 19. Piping Configuration: Piping and components mounted off stands both on top of and below chamber in configuration designed for ease of servicing, including unions before and after individual components.
 - a. Left Hand / Right Hand Configuration: As practicable for each unit location indicated on drawings.
 - b. Valves: Solenoid-activated, pneumatically-operated, normally-closed ball valves for steam, water and exhaust, unless otherwise indicated.
 - 1) Check Valves: Swing type.
 - 2) Valves' materials compatible with utility service.
 - 3) Identifier tag for each valve.

- 4) Standard, non-proprietary pneumatic and hydraulic components.
20. Air Inlet Filter: Hydrophobic type bacterial retentive absolute air filter, 0.2 micron mounted external to chamber with replaceable element.
21. Sensors and Gauges: As appropriate to units specified. Installed to be easily removable for calibration except where required to be calibrated in place.
22. Drain RTD: Single RTD in the drain to monitor sterilization temperature throughout the cycle. Process temperature recorded on printout.
23. Drainage: Sloped piping to reduce condensate collection areas connected to the chamber. Stainless steel basket screens on chamber drains.
24. High Water Dump and Alarm: Drain line piping system and alarm.
 - a. Functionality: Removal of excess condensate from chamber drain line before the condensate can impede the operation of the controlling RTD in the drain line, or contact the lowest product container in the autoclave chamber. Non-clogging type automatic drain valve located in the chamber opening if condensate exceeds pre-determined water level. Activation of visual and audible alarm.
25. Effluent Temperature Cooling and Control System: Integral system to ensure maximum effluent temperature discharged to floor drain does not exceed 140 degrees F (60 degrees C).
26. Accessories: Provide the following items:
 - a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Loading Equipment: Single set of loading equipment, including Type 316L stainless steel loading cart, transfer carriage, general purpose rack and two shelves, and chamber tracks.
 - c. _____.
27. Options: Provide the following items:
 - a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Integral Indirect Clean Steam Generator and Piping: Manufacturer's recommended complete system.
 - 1) Designed to use the building's steam (minimum 75 psig (517 kPa), and high-quality water (minimum specific resistivity of 1 Mega Ohm·cm), to supply pure steam to the steam sterilizer. Generator system integrally mounted to the sterilizer framework. Automatically operated by sterilizer's electronic control system. Clean steam-to-chamber piping.
 - c. Integral Electric Steam Generator: Sized to match sterilizer requirements. Positioned behind or to the side of the sterilizer.
 - d. Bioseal (Double-Door Units Only):
 - 1) 1/4 inch (6.3 mm) stainless-steel plate welded to the chamber and a 1/4 inch (6.3 mm) thick silicone gasket extending between the plate and a carbon steel wall frame welded to wall imbeds.
 - 2) Located at operating end of the sterilizer to prevent the passage of airborne microorganisms from the space between the vessel body and the structural wall opening.
 - 3) Primary source of pressure behind the door seal provided by steam.
 - 4) Compressed air back-up to maintain seal pressure when out of cycle or if the steam source is not available.
 - e. Barrier Wall Flange Kit: Stainless-steel flanges for sealing the opening between the recessed washer and wall.
 - f. Modular Wall Panel Enclosures: Non-progressive, self-supporting, demountable metal partition system for completing recessed installations involving several pieces of equipment.
 - 1) Modular wall panel enclosures are specified in Section 11 53 20.
 - g. _____.

28. Utility Requirements:

- a. Electrical: 3 phase, 60 Hz, _____ HP; _____ kW.
- b. Steam: 1 inch NPS FPT (25 mm DN); 50-80 psi (345-551 kPa); 255 pounds per hour (116 kg per hour) maximum flow, and 148 pounds per hour (67 kg per hour) average flow. Condensate free, and 97 percent to 100 percent vapor quality.
- c. Condensate: 1 inch NPS FPT (25 mm DN).
- d. Hot Water: 1 1/2 inch NPS FPT (40 mm DN); 35 psi (241 kPa); 120-180 degrees F (48.9-82.2 degrees C); 200 gallons per load (757 liters per load) maximum.
- e. Drain Outlet: 2 inch NPS FPT (50 mm DN); 140 degrees F (60 degrees C) maximum; 120 GPM (454 l/min) maximum.
- f. Exhaust: 12 inches (305 mm) diameter; 600 CFM (17 m³/min); 180 degrees F (82.2 degrees C), saturated.
- g. Compressed Air: 1/2 inch NPS FPT (15 mm DN); 80 psi (551 kPa); 4 CFM (0.11 cubic m/min).
- h. Cold Water (Optional): 1 inch NPS FPT (25 mm DN); 35 psi (241 kPa); 25 GPM (95 l/min).

2.4 GLASSWARE WASHERS

- A. Type _____, Glassware Washer: (CFCI) Undercounter capacity.
1. Basis of Design: Model _____, as specified herein and manufactured by _____.
 2. General: High-performance commercial-quality washer specifically designed for cleaning laboratory glassware of many sizes and types, with programmable treatment options and controlled intake of chemicals.
 - a. UL listed and/or approved electrical devices and components, bearing NEMA MG 00001, IEC or other recognized International ratings, as appropriate for the use intended. Low-voltage DC outputs external to the electrical box.
 3. Cabinet Enclosure: Yes.
 4. Mounting: On floor, undercounter.
 5. Chamber Interior Dimensions: 21 inches wide by 20 inches high by 20 inches front-to-back (535 mm wide by 508 mm high by 508 mm front-to-back).
 6. Heating: Steam.
 7. Operating Weight: _____ pounds (_____ kg).
 8. Doors: Number, type, and construction indicated.
 - a. Number of Doors: Two.
 - b. Operation: Front, drop-down, manually-operated, spring counterbalanced; capable of supporting full glassware load and functioning as a loading platform to eliminate the requirement for a loading trolley; double-wall construction; insulated to minimize noise and surface temperature.
 - c. Operation: Vertical-sliding, power-operated, dynamically pressing door against gasketing and ensuring complete air and water tightness of wash chamber.
 - d. Interlock feature on double-doors unit.
 - e. Double-pane tempered glass viewing panel.
 - f. Gaskets: Manufacturer's standard for type door specified, manufactured to withstand temperatures and pressures generated.
 9. Interior Illumination: Manufacturer's standard luminaire(s) located on top of the Washer, complete with electronic ballast, gasketed tempered safety glass diffuser, and using fluorescent lamps.
 10. Washing System: Manufacturer's standard, configured for two-level loading and washing, and rinse-water source options.
 - a. Materials: Type 304 stainless steel.
 11. Operator Controls: Digital type, with touch screen controls and multi-level menus.
 - a. Reprogrammable cycle configurations.

- b. Continuous cycle monitoring and control.
 - c. Continuous service diagnostics.
 - d. Virtual Keypad: Allowing operator to easily control all programmable equipment functions, access all equipment monitoring functions, and operate the equipment. At a minimum, allowing the following functionality:
 - 1) Selecting a program.
 - 2) Presetting main parameters, including sterilization temperature and time, dry time, and set real time clock.
 - 3) Starting a cycle.
 - 4) Stopping a cycle.
 - e. Status Indication: Showing status of critical equipment operation. At a minimum, provide indicators for:
 - 1) Start: Indicating required temperature is available for unit operation.
 - 2) Heat: Indicating unit is in the heating stage.
 - 3) Steam: Indicates unit is in the timed sterilization stage.
 - 4) Exhaust: Indicates unit is in the exhaust stage.
 - 5) Drying: Indicates unit is in the drying stage.
 - 6) Fail: Indicates system has failed as a result of protective cut-off or because Stop button has been pressed. Failure message appears on display.
 - 7) Door Closed: Indicates door is properly closed.
 - f. Printer: Provide 24 character (minimum) per line printer integrated into control panel to provide hard copy of all relevant information concerning operation during each cycle including temperature, pressure, vacuum, sterilization and drying time, number of cycles, etc. In case of uncompleted cycle, include printout indicating cycle failure and cause of cycle failure.
 - g. Non-operating end (NOE) control panel, equipped on double-door washers only: A touch-sensitive screen similar to the operating end screen. Preprogrammed cycles can be started from the NOE control panel. The display concurrently shows the same information as the operating end screen display.
12. Control and Monitoring System: Controller, gauges, sensors and wiring.
- a. Controller: Microcomputer based controller monitoring and controlling all aspects of equipment cycle and process operations. Provide battery backup of microprocessor memory. Controller to ensure fully automatic operation through all equipment cycles.
 - b. Temperature gauges.
13. Operations Programming: Washer designed to operate a minimum 10 of washing cycles, each including up to 18 treatments.
- a. Pre-wash: Up to (2) two programs.
 - b. Wash: Up to (3) three programs.
 - c. Rinse: Up to (3) three programs.
 - d. Pure water rinse and drying: Up to (9) nine programs.
14. Cycle Descriptions: Basic types included, as indicated.
- a. Pre-Wash Cycle: Load sprayed with recirculated water at operator-selected temperature of up to 203 degree F (95 degrees C). Required.
 - b. Wash Cycle: Load sprayed with recirculated solution at operator-selected temperature of up to 203 degrees F (95 degrees C) for an operator-selected interval in range of 0-15 minutes. Cycle programmed not to start until selected temperature is reached. Required.
 - c. Rinse Cycle: Load sprayed with recirculated water at operator-selected temperature of up to 203 degrees F (95 degrees C) for an operator-selected duration in range of 0-15 minutes. Cycle programmed not to start until selected temperature is reached. Required.

- d. Pure Water Rinse Cycle: Load sprayed with recirculated water at operator-selected temperature of up to _____ degrees F (_____ degrees C) for an operator-selected duration in range of 0-15 minutes. Cycle programmed not to start until selected temperature is reached. Required.
- e. Drying Cycle (Optional): HEPA-filtered heated air circulated through piping, spindles, load items and chamber for operator-selected duration in range of 0-30 minutes.
- 15. Personnel Safety: Integrated personnel safety features typical to the industry.
 - a. Safety Door Switch(es): Preventing cycle operation if door(s) not fully-closed.
 - b. Safety Sensor: Retracting door if obstruction is detected in the doorway.
 - c. Effective design, insulation and fabrication preventing hot surfaces on the exterior of the unit.
- 16. Wash Chamber: Rectangular design, with internal corners longitudinally radiused and polished. All welds ground smooth and polished.
 - a. Material: Type 304L stainless steel, No.4 finish.
- 17. Spray System: Manufacturer's standard.
 - a. Two manifold connectors positioned on the bottom of the chamber and one rotary spray arm(s) suspended from the top of the chamber. Manifold connectors automatically connecting to accessory headers at the start of each cycle. Additional connectors installed on chamber sides to accommodate optional universal shelves (used to process loads on two levels). Screens and recirculation piping included.
 - b. Type 316L stainless steel dual-speed pump.
 - 1) Pump impeller, shaft, and casing fitter with a mechanical seal.
 - 2) Drip-proof frame, magnetic starter, overload protection and sealed bearings.
- 18. Insulation: Manufacturers standard type, with vapor-retarder, covering the outer top, sides and bottom of washer chamber.
- 19. Sensors and Gauges: Provide as appropriate to units specified. Install to be easily removable for calibration except where required to be calibrated in place.
- 20. Effluent Temperature Cooling and Control System: Integral system to ensure maximum effluent temperature discharged to floor drain does not exceed _____ degrees F (_____ degrees C).
- 21. Accessories: Provide the following items:
 - a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Universal Transfer Cart: Manufacturer's standard, compatible with washer.
 - c. Rack Storage Cart: Height-adjustable, for storing accessory racks.
 - d. Upper and lower standard racks.
 - e. Lower Spindle Rack: Manufacturer's standard, designed to accommodate 36 various length spindles for direct-injection cleaning of narrow-neck and specialty glassware.
 - 1) 36 detachable, nylon-tipped injection spindles, threaded into rack, with adjustable height clips.
 - f. Upper Spindle Rack: Manufacturer's standard, designed to accommodate 30 various length spindles for direct-injection cleaning of narrow-neck and specialty glassware.
 - 1) 30 detachable, nylon-tipped injection spindles, threaded into rack, with adjustable height clips.
 - g. General-purpose Basket: Manufacturer's standard size compatible with washer.
 - h. Additional Pumps: Field-installed, for injection of different chemicals during desired treatments.
 - 1) Manufacturer's standard chemicals containers; _____ feet (_____ m) of tubing and electrical wiring; pick-up tubes; and low-level sensors.
 - i. Steam Condensate Return-to-Drain Kit: Field-installed piping to connect the condensate return outlet to the drain on the washer.
 - j. Manufacturer's Flexible Shelving System: Removable single shelf.

- 1) Functionality: Two-level configuration for part of wash chamber, allowing processing of small, medium and large glassware items simultaneously.
 - k. Manufacturer's Flexible Shelving System: Removable double shelf.
 - 1) Functionality: Two-level configuration for two-thirds of the wash chamber, allowing processing of small, medium and large glassware items simultaneously.
 - 2) Additional single shelf.
 - l. Air Compressor: Field-wired. Dedicated unit complete with automatic tank drain and pressure switch.
 - m. Barrier Wall Flange Kit: Stainless-steel flanges for sealing the opening between the recessed washer and wall.
 - n. _____.
22. Options: Provide the following items:
- a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Non-recirculated Heated Pure Water Rinse Treatment: Programmed to spray the load with heated pure water.
 - 1) Configuration: Supplied from integral electropolished Type 316L stainless steel tank equipped with automatic fill and level control. Treatment programmed to use recirculated pure water. Steam heating coil located in the bottom of the storage tank to heat and maintain pure water temperature up to 203 degrees F (95 degrees C).
 - c. Non-vented Vapor Condenser: System for exhausting vapor through a cold-water condenser to the room.
 - 1) Building Service requirement: Cold water.
 - d. Vented Drying System Treatment: Programmed to occur after the final rinse treatment of a cycle.
 - 1) Operation: HEPA-filtered air heated to operator-selected temperature and recirculated through the chamber and accessory headers, with a portion exhausted to vent. Manufacturer's standard blower and electric heaters.
 - e. Non-Vented Drying System Treatment: Programmed to occur after the final rinse treatment of a cycle.
 - 1) Operation: During drying treatment, HEPA filtered air heated to operator-selected temperature and recirculated through the chamber and accessory headers, with a portion is exhausted to the room through a cold water condenser. Plate heat exchanger for energy recovery, using hot exhaust air to pre-heat fresh incoming air.
 - f. Effluent Heat Recovery System: Cooling system combined with an energy recovery system that pre-heats incoming process water.
 - 1) Operation: Cold water circulated through a stainless-steel coil located in the integrated stainless-steel drain tank to cool down the effluent prior to drain. The heat from the effluent is transferred to the cold water which is subsequently used for the cleaning cycle. The system eliminates the need for connecting the washer to a hot water supply line and reduces the need to send cold water to drain for cooling purpose.
 - g. Detergent Drawer: Storage and feed system integrated with washer.
 - 1) Capacity: Two _____ gallon (_____ l) containers with pick-up tubes and low-level sensors.
 - h. Modular Wall Panel Enclosures: Non-progressive, self-supporting, demountable metal partition system for completing recessed installations involving several pieces of equipment.
 - 1) Modular Wall Panel Enclosures are specified in Section 11 53 20.
 - i. _____.
23. Utility Requirements:

- a. Electrical: 3 phase, 60 Hz, _____ HP; _____ kW.
- b. Steam: 1/2 inch NPS FPT (15 mm DN); 50-80 psi (345-551 kPa); condensate free, and 97 percent to 100 percent vapor quality.
- c. Condensate: 1/2 inch NPS FPT (15 mm DN).
- d. Cold Water: 1/2 inch NPS FPT (15 mm DN); 35 psi (241 kPa) minimum.
- e. Hot Water: 1/2 inch NPS FPT (15 mm DN); 35 psi (241 kPa) minimum; 120-180 degrees F (48.9-82.2 degrees C).
- f. Pure Water: 1/2 inch NPS FPT (15 mm DN); 35 psi (241 kPa).
- g. Drain Outlet: 1 1/2 inch NPS FPT (40 mm DN); 140 degrees F (60 degrees C) maximum.
- h. Compressed Air: 1/8 inch NPS FPT (6 mm DN).
- i. Ventilation: A dedicated 3 inch (76 mm) flexible, corrosion-resistant, watertight duct to exterior of building, sloped towards washer.

2.5 ICE MAKERS

- A. Type _____, Ice Maker: (CFCI) Ice machine(s) and storage bin combination unit.
 1. Basis of Design: Model _____, as specified herein and manufactured by _____.
 2. General: High-performance commercial-quality ice machine and storage bin combination specifically designed for making ice of selected sizes and shapes for laboratory use.
 - a. UL listed and/or approved electrical devices and components, bearing NEMA MG 00001, IEC or other recognized International ratings, as appropriate for the use intended. Low-voltage DC outputs external to the electrical box.
 3. Ice Shape: Cubes.
 4. Production: 24-hour volume of 233 pounds (106 kg).
 5. Number of Ice Machines: One.
 6. Storage Bin Capacity: 370 pounds (168 kg).
 7. Condenser Type: Air-cooled.
 8. Refrigerant: R-404A.
 9. Mounting: Floor-mounted storage bin on legs with levelers, bin-mounted ice machine, with bin adapter.
 10. Ice Machine:
 - a. Stainless steel auger with greaseless bearing.
 - b. Front-located air filter.
 - c. Anti-microbial agent protection.
 - d. Flush cycle operation for sediment removal.
 - e. Controls: Digital.
 - 1) Status Indication: Showing status of critical equipment operation.
 - 2) Operational Data Handling: Electronic storage and display.
 - 3) On/off switch.
 - 4) Ice/drain switch.
 - 5) Alarm conditions signaling.
 - (a) Low water supply.
 - (b) Drain sequence exceeding OEM duration setting.
 - (c) Water valve not coming on within OEM set interval since the previous activation.
 - (d) Low voltage on power supply.
 - (e) High voltage on power supply.
 - (f) _____.
 11. Sensors and Gauges: Provide as appropriate to units specified. Install to be easily removable for calibration except where required to be calibrated in place.
 - a. Infrared sensor for controlling level of ice in ice machine/storage bin.

12. Accessories: Provide the following items:
 - a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Ice Maker-to-Bin Adapter(s): Manufacturer's standard; quantity and configuration coordinated with ice machine/storage bin selections specified.
 - c. _____.
13. Options: Provide the following items:
 - a. Refer to Section 01 23 00 for description of base bid and alternates scope of work.
 - b. Remote Condenser: Type and capacity recommended by ice machine manufacturer.
 - c. _____.
14. Utility Requirements Ranges:
 - a. Ambient Air Temperatures: 50 to 100 degrees F (10 to 38 degrees C).
 - b. Incoming Water Temperature: 40 to 100 degrees F (4.4 to 38 degrees C).
 - c. Remote Condenser Ambient Air Temperature: Minus 20 to 120 degrees F (Minus 29 to 49 degrees C).
 - d. Incoming Water Pressure: 20 to 80 PSIG (1.4 to 5.5 bar).
 - e. Drain Outlet: 3/4 inch NPS FPT (20 mm DN); 140 degrees F (60 degrees C) maximum.
 - f. Electrical Voltage Fluctuation: Minus 5 percent to plus 10 percent.
 - g. Electrical: 1 phase, 60 Hz, 115 V; _____ kW.

2.6 MATERIALS

- A. Aluminum Sheet: ASTM B209 or ASTM B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
 1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.
- D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: ASTM C1172.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.

- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
 - 1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.
 - 1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.
 - 2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.
 - 3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.4 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Owner. Replace any parts that cannot be repaired in such a manner.

END OF SECTION 11 53 00

SECTION 11 53 13 - LABORATORY FUME HOODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. Section Includes:
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring fume hoods.
 - 2. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring fume hoods.
 - 3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Field quality-control testing of fume hoods.
 - 4. _____.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z9.5 - Laboratory Ventilation; 2022.
- C. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016, with Errata.
- D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2025a.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024.
- H. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2024.
- I. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
- J. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2024.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- M. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- N. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- O. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- P. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals; 2019.
- Q. SEFA 1 - Laboratory Fume Hoods; 2010.
- R. SEFA 2 - Installations; 2010.
- S. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.
- B. Preinstallation Meeting: Conduct preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations, and _____.
- C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings, and _____.
- D. Samples: Submit two samples of exterior, interior, and work top finish surfaces, ____ by ____ inch (____ by ____ mm) in size illustrating color and finish.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide documentation of successful Factory Acceptance Testing.
- F. Test Reports: Indicate that each type of fume hood has been factory-tested and meets specified ASHRAE Std 110 (AM) requirements.
- G. Manufacturer's Installation Instructions: Indicate special installation requirements and _____.
- H. Operation Data: Include description of equipment operation and required adjusting and testing.
- I. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- K. Project Record Documents: Record actual locations of concealed utility connections.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Testing: Factory-test each type of hood as per referenced standard.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.8 FIELD CONDITIONS

- A. Ambient Conditions: Maintain temperature and relative humidity at occupancy levels during and after installation of fume hoods.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide one year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Provide laboratory fume hoods from single manufacturer.
- C. Provide laboratory fume hoods from same manufacturer as laboratory casework.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Code Standards:
 - a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
 - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 CONSTANT AIR VOLUME (CAV) FUME HOODS

- A. Bypass Fume Hoods:
 - 1. Include a built-in compensating bypass arrangement to maintain constant exhaust volume regardless of sash position.
 - a. Design bypass functionality so that face velocity as the sash is being closed down to 6 inches (152 mm) does not exceed three times the face velocity with sash fully open.
- B. Auxiliary Air System:
 - 1. Include an-air outlet for connection to an external supply air source equal to 70 percent of the exhausted air volume. Introduce air directly above and immediately in front of hood face.

2.4 VARIABLE AIR VOLUME (VAV) FUME HOODS

- A. Restricted-Bypass Fume Hoods:
 - 1. Provide a compensating bypass arrangement above the sash to open after sash is closed to less than 20 percent open. Bypass to maintain exhaust capacity of at least 25 CFM per square foot (127 L/s per square meter) of work surface regardless of sash position.
 - 2. Provide an electronic control unit designed to use input from a sensor that monitors face velocity or sash position to modulate a dedicated exhaust damper in order to maintain a near-constant fume hood face velocity.
 - a. Provide control unit with a manual-override switch that allows the operator to fully open the exhaust damper.
 - b. Provide control unit with outputs for interfacing with building's HVAC control system.

2.5 PERFORMANCE REQUIREMENTS

- A. Fume hoods complying with the following when tested in accordance with ASHRAE Std 110:
 - 1. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm).
 - 2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
 - 3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.

4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sash(es) fully open.
 - a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
5. Release Rate: 4.0 L/min.
6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.
7. Seismic Performance: Design fume hoods, including attachments to other work, to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Refer to Drawings for Design earthquake spectral response acceleration, short period (Sds) for Project.
 - b. Component Importance Factor: 1.0.

2.6 FUME HOODS

- A. General Requirements:
 1. Comply with SEFA 1.
 - a. Provide fume hoods UL listed and labeled for compliance with UL 1805.
 2. Pre-pipe fume hoods for service fittings.
 3. Pre-wire fume hoods for light fixtures and receptacles.
 - a. Terminate all wiring in a junction box on top of hood.
- B. Fume Hood:
 1. Ventilation: Variable Air Volume (VAV).
 2. Configuration: Sitting-height; bench mounted.
 3. Nominal Interior Height: 48 inches (1219 mm).
 4. Sash Type: Vertical rising.
 - a. Configuration: As indicated on drawings.
 - b. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
 - c. Horizontal Sashes: By-passing and removable sashes hung from adjustable nylon-tired, ball-bearing sheaves, supported on an overhead stainless-steel track; lower track only for guiding sashes; flush finger pulls and rubber bumpers at both stiles of each sash.
 - d. Glazing: Laminated safety glass.
 - e. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
 - f. Vertical Sash mechanism: Designed to prevent sash drop in case of mechanism failure.
 - 1) Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer.
 - (a) Sprocket system for Sash Chain: Hardened sprockets with one full-width shaft per sash, running in ball-bearings.
 - g. Vertical Sash Pull: Type 316 stainless steel, with No.4 finish.
 - h. Sliding Safety Shield: Manufacturer's standard removable polycarbonate shield able to slide the full width of fume face opening, with ball-bearing rollers at top for suspension from track at top of sash opening, and guide at bottom to keep shield from swinging.
 5. Top Front Panel: Standard integral grille stamped into panel of same materials as fume hood exterior.

6. Exterior: Sheet steel.
 - a. Color/Finish: _____.
 7. Interior Lining: Polypropylene.
 - a. Color/Finish: White.
 8. Service Fittings and Fixtures:
 - a. As specified in Section _____.
 - b. Cup Sink Type: _____: Drop-in Epoxy, complete with removable stainer and waste fitting, side-mounted at floor-mounted fume hood.
 - 1) Shape: Round.
 - 2) Size: 5 inch (127mm) diameter.
 - c. Natural Gas Fitting Assembly: Model _____ manufactured by _____.
 - d. Specialty Gas Fitting Assembly: Model _____ manufactured by _____.
 - e. Steam Outlet Fitting Assembly: Model _____ manufactured by _____.
 - f. Compressed Air Outlet Fitting Assembly: Model _____ manufactured by _____.
 - g. Vacuum Outlet Fitting Assembly: Model _____ manufactured by _____.
 - h. Water Outlet Fitting Assembly: Model _____ manufactured by _____.
 - i. Vacuum-breaker Assembly: Model _____ manufactured by _____.
 - j. Escutcheons: Stainless steel.
 9. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.
 10. Work Surface:
 - a. Work Top for Fume Hoods Other Than Floor-mounted Type: Epoxy resin.
 - 1) Edge: Raised rim with rounded edges and corners.
 - 2) Full width drain trough at rear.
 - b. Floor at floor-mounted fume hoods :
 - 1) Material: Solid epoxy, 1 inch (25 mm) thick with 1/2 inch (13 mm) high, raised (marine) edge.
 - 2) Distillation Shelf: Manufacturer's standard shelf, attachable to side walls of fume hood.
- C. Type _____, Fume Hood:
1. Ventilation: Variable Air Volume (VAV).
 2. Configuration: Floor mounted.
 3. Nominal Interior Height: 60 inches (1524 mm).
 4. Sash Type: Vertical rising, two bypass type.
 - a. Configuration: As indicated on drawings.
 - b. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
 - c. Horizontal sashes: By-passing and removable sashes hung from adjustable nylon-tired, ball-bearing sheaves, supported on an overhead stainless-steel track; lower track only for guiding sashes; flush finger pulls and rubber bumpers at both stiles of each sash.
 - d. Glazing: Laminated safety glass.
 - e. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
 - f. Vertical Sash Mechanism: Design to prevent sash drop in case of mechanism failure.
 - 1) Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer.
 - (a) Sprocket System for Sash Chain: Hardened sprockets with one full-width shaft per sash, running in ball-bearings.
 - g. Vertical Sash Pull: Type 316 stainless steel, with No.4 finish.

- h. Sliding Safety Shield: Provide manufacturer's standard removable polycarbonate shield able to slide the full width of fume face opening. Provide ball-bearing rollers at top for suspension from track at top of sash opening. Provide guide at bottom to keep shield from swinging.
 - 5. Top Front Panel: Standard integral grille stamped into panel of same materials as fume hood exterior.
 - 6. Exterior: Sheet steel.
 - a. Color/Finish: _____.
 - 7. Interior Lining: Type 316 stainless steel, 18 gauge, with No.4 finish.
 - a. Color/Finish: White.
 - 8. Service Fittings and Fixtures:
 - a. As specified in Section _____.
 - b. Cup Sink Type: _____: Drop-in epoxy, complete with removable strainer and waste fitting, side-mounted at floor-mounted fume hood.
 - 1) Shape: Oval.
 - 2) Size: 3 inches by 9 inches (75 by 228 mm).
 - c. Natural Gas Fitting Assembly: Model _____ manufactured by _____.
 - d. Specialty Gas Fitting Assembly: Model _____ manufactured by _____.
 - e. Steam Outlet Fitting Assembly: Model _____ manufactured by _____.
 - f. Compressed Air Outlet Fitting Assembly: Model _____ manufactured by _____.
 - g. Vacuum Outlet Fitting Assembly: Model _____ manufactured by _____.
 - h. Water Outlet Fitting Assembly: Model _____ manufactured by _____.
 - i. Vacuum-breaker Assembly: Model _____ manufactured by _____.
 - j. Escutcheons: Stainless steel.
 - 9. Access Panels: Removable panels on both sides hood exterior and interior lining panels.
 - 10. Work Surface:
 - a. Work Top for Fume Hoods Other Than Floor-mounted Type: Epoxy resin.
 - 1) Edge: Raised rim with rounded edges and corners, and coved for stainless steel.
 - 2) Full width drain trough at rear.
 - b. Floor at floor-mounted fume hoods:
 - 1) Material: Solid epoxy, 1 inch (25 mm) thick with 1/2 inch (13 mm) high, raised (marine) edge.
 - 2) Distillation Shelf: Manufacturer's standard shelf, attachable to side walls of fume hood.
- D. Fume Hood Base Cabinets:
- 1. Exterior Construction: {CH#96912}.
 - 2. Material: {CH#113610}.
 - 3. Color/Finish: As indicated on drawings.
 - 4. Exterior construction: Wood Cabinets.
- E. Light Fixtures: UL labeled, vaporproof, one-tube, T-5 fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.

2.7 FABRICATION

- 1. Material: Sheet steel.
- B. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a 35 inches by 79 inches (889 mm by 2007 mm) clear door opening.
- 1. Color/Finish: As indicated on drawings.

- C. Steel Exterior: Fabricated from steel sheet, 0.048 inch (1.21 mm) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Chemical-resistant finish applied to interior and exterior surfaces of component parts before assembly.
- D. Stainless-Steel Exterior: Fabricated from stainless-steel sheet, 0.050 inch (1.27 mm) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil, and to allow access to plumbing lines and service fittings.
- E. Fiberglass Exterior: Fabricated from glass-fiber-reinforced polyester components not less than 1/4 inch (6.35 mm) thick, bonded together to maximum extent practical. Edges of panels trimmed with PVC extrusion. Removable parts limited to access panels, front fascia, and airfoil.
- F. Polypropylene Exterior: Fabricated from fully stress-relieved polypropylene sheet, 1/2 inch (12.7 mm) thick, with welded seams. 1/4 inch (6.35 mm) thick, flush mounted access panels fastened with flat-head polypropylene screws.
- G. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- H. Splayed top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
- I. Front Double-Wall Posts: Pre-punched to accept up to five (5) plumbing fixtures per side; two (2) duplex electrical receptacles; light switch; airflow indicator and alarm.
- J. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.
 - 1. Lining components fastened together with stainless-steel cleats or angles to form a rigid assembly to which exterior panels are attached.
 - 2. Lining components fastened to a rigid frame assembly fabricated from stainless-steel and to which exterior panels are attached.
 - 3. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.
- K. Molded Glass-Fiber-Reinforced Polyester Lining: Molded unit consisting of end panels, back panel, preset rear baffle, and top bonded together into a single piece; reinforced to form a rigid assembly to which exterior is attached.
 - 1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.
- L. Stainless-Steel Lining Assembly: Fully-welded unit consisting of end, back, and top panels, and work top with spill-containing raised edges; reinforced to form a rigid assembly.
 - 1. For perchloric acid and radioisotope fume hood linings: Coved corners and completely welded seams; surfaces ground smooth, and polished as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivated and rinsed surfaces; embedded foreign matter removed, leaving surfaces clean.
- M. Rear Baffle: Same material as fume hood lining, unless otherwise indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.
 - 1. Preset baffles, unless otherwise indicated.
 - 2. Adjustable baffles with control adjustment strips at top and bottom with plastic or stainless-steel knobs.
 - 3. Adjustable baffles with remote-control adjustment from outside front of fume hood, unless otherwise indicated.

4. Epoxy-coated, stainless-steel screen at bottom baffle opening to prevent light items from being drawn into the rear exhaust plenum.
- N. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.
 1. Duct-Stub Material: Epoxy-coated steel, unless otherwise indicated.
 2. Duct-Stub Material for Radioisotope Hoods: Stainless steel.
- O. Bypass Grilles: At bypass openings of fume hoods.
- P. Airfoil: At bottom of fume hood face opening, with 1 inch (25.4 mm) gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.
 1. Fabricated from 14 gauge, 0.0781 inch (1.98 mm) stainless steel with No.4 finish.
- Q. Filler Strips: As needed to close spaces between fume hoods and/or fume hood base cabinets and adjacent building construction. Fabricated from same material and with same finish as fume hoods or fume hood base cabinets, as applicable. Flange, notch, and reinforce filler strips. Fabricate to form well-fitting closures, free from oil-canning.
- R. Ceiling Extensions: Filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods, and extending from tops of fume hoods to approximately 4 inches (102 mm) above ceiling. Flange, notch, and reinforce ceiling extensions as required for rigidity. Fabricate to form well-fitting closures, free from oil-canning.
 1. Provide bottom-hinged access panels within the front ceiling extension filler panel to facilitate access to light fixture and other fume hood components at top of hood not readily accessible by other means.
- S. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.
- T. Perchloric Acid Fume Hood Washdown System: System consisting of stainless-steel spray nozzles, washdown valve, and associated piping. Design system to thoroughly rinse all surfaces of fume hood interior, including areas behind and above baffles, and to direct rinse water toward drain trough at rear of work top. Provide T-fitting for extending system to additional spray nozzles in exhaust ducts.
- U. Demonstration (teaching) Fume Hoods: Single chamber fume hood, with independently-operable sashes on opposite faces of fume hood. Construction similar to standard models.
 1. Optional glazed viewing window on left side of fume hood.
 2. Lattice Assemblies ____: Aluminum vertical and horizontal rod lattice assembly with 1/2 inch (12.7 mm) diameter rods at approximately 12 inches (305 mm) on center with two flush socket receptacles for mounting.
 - a. Vertical Rods: For each assembly, two rods with tapered end to fit socket receptacles.
 - 1) Length: 48 inches (1219 mm).
 - b. Horizontal Rods: For each assembly, one rod with rounded ends.
 - 1) Length: 24 inches (610 mm).
 - c. Bases: Opening size coordinated with rod diameter, and including mounting screws appropriate to mounting substrate.
 - d. Connectors: Opening size coordinated with rod diameter, open-type, closed-type, and rod-coupler-type, with T-handles.
 3. _____.
- V. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

2.8 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
 - 1. For perchloric acid fume hoods, use Type 316L instead of Type 304.
- C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E84.
- D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.
 - 1. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 pounds per square inch (70 MPa).
 - b. Modulus of Elasticity: Not less than 2,000,000 pounds per square inch (1,400 MPa).
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 degrees F (127 degrees C).
 - f. Flame-Spread Index: 25 or less according to ASTM E84.
 - 2. Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect:
 - 1) Acetic acid (98 percent).
 - 2) Acetone.
 - 3) Ammonium hydroxide (28 percent).
 - 4) Benzene.
 - 5) Carbon tetrachloride.
 - 6) Dimethyl formamide.
 - 7) Ethyl acetate.
 - 8) Ethyl alcohol.
 - 9) Ethyl ether.
 - 10) Methyl alcohol.
 - 11) Nitric acid (70 percent).
 - 12) Phenol.
 - 13) Sulfuric acid (60 percent).
 - 14) Toluene.
 - b. Slight Effect:
 - 1) Chromic acid (60 percent).
 - 2) Sodium hydroxide (50 percent).
 - 3. Color: Black.
- E. Polypropylene: Unreinforced polypropylene complying with ASTM D4101, Group 01, Class 1, Grade 2.
- F. Laminated Safety Glass: ASTM C1172.
- G. Polycarbonate Glazing: Clear, uncoated polycarbonate sheet manufactured by extrusion process and complying with the following requirements:
 - 1. Impact Resistance: 12 to 16 foot-pounds of force per inch (640 to 850 J/m) in accordance with ASTM D256, Method A.
 - 2. Elongation and Modulus of Elasticity: 110 percent maximum and 340,000 pounds per square inch (2,345 MPa), respectively, in accordance with ASTM D638.
 - 3. Heat Deflection: 270 degrees F (132 degrees C) at 264 pounds per square inch (1,820 kPa), in accordance with ASTM D638.
 - 4. Flame-Spread Index: 25 or less, in accordance with ASTM E84.

- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Fasteners: Stainless-steel, where exposed to fumes.

2.9 ACCESSORIES

- A. Differential Pressure Gauge: Direct-reading aneroid gauge that measures the difference in static pressure between the laboratory space and the fume hood exhaust duct.
- B. Airflow Monitors/Indicators and Alarms: Provide each fume hood with a airflow monitor/indicator complete with an audible and visual alarm that activates when airflow sensor reading is outside of preset range.
 - 1. Source: Fume hood manufacturer.
 - 2. Airflow Monitor/Indicator Functionality:
 - a. Type: A sensor module that monitors fume hood face airflow velocity, and a display module that indicates whether velocity it is below normal, normal, or above normal.
 - 1) Input Power: 9 to 30 V AC/DC. Include power supply module or functionality.
 - 2) Alarm Range: 50 to 250 FPM (0.25 to 1.27 m/s).
 - 3) Alarm Setpoints: Low.
 - 4) Mounting: Flush.
 - 5) Readings: Remote sensor inserted in airflow stream.
 - 6) Accuracy: Maximum plus or minus 5 percent of set point.
 - 7) Visual Status Display: Green, yellow, and red LEDs.
 - 8) Operating Temperature: 55 to 86 degrees F (13 to 30 degrees C) .
 - b. Type: A sensor module that monitors fume hood face velocity, and a display module that presents data as digital readout.
 - 1) Input Power: 9 to 30 V AC/DC. Include power supply module or functionality.
 - 2) Display Range: 0 to 1,000 FPM (0 to 5.08 m/s).
 - 3) Alarm Condition Range: 50 to 250 FPM (0.25 to 1.27 m/s).
 - 4) Alarm Setpoints: Low and High.
 - 5) Mounting: Flush.
 - 6) Readings: Remote sensor inserted in airflow stream.
 - 7) Accuracy: Maximum plus or minus 5 percent of set point.
 - 8) Visual Status Display: Green, yellow, and red LEDs.
 - 9) Airflow Display: Digital display of face velocity reading.
 - 10) Operating Temperature: 55 to 86 degrees F (13 to 30 degrees C) .
 - 3. Airflow Alarm functionality: Audible (85 dB @ 4 inch (102 mm) distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
 - a. Reset and test mode.
 - b. Programmable Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
 - c. Programmable relay output.
 - d. Capability for integration with BAS (Building Automation System) via BACnet.
 - e. Alarm included as an integral feature of the airflow monitor/indicator.
- C. Fume Hood Controller: Airflow Indicator/monitor with built-in electronics to control a dedicated exhaust fan and/or exhaust valve.
 - 1. Fume hood manufacturer's standard controller.
 - 2. Controller is part of a control system specified in Section _____.
 - 3. Controller is part of a facility automation controls system.
- D. Sash Alarms: Audible and visual alarm that activates when sash is opened beyond preset position.
 - 1. Programmable silence and test switches.

2. Sash Alarm integrated with Airflow Alarm.
- E. Sash Stops: Spring-loaded stops to limit hood opening to 18 inches (457 mm) height. Manually releasable to open sash fully, and to reset automatically when sash is lowered below set level.
- F. Bypass Grille Blank-off Panel: On bypass grille, designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.
- G. Variable Transformer Type ____: On/off control switch and a transformer with single voltage input and variable voltage output, of the following configuration:
 1. Single-Phase:
 - a. Input: 120 VAC; Output - 0 to 140 VAC.
 - b. Input: 240 VAC; Output - 0 to 280 VAC.
 - c. Input: 480 VAC; Output - 0 to 560 VAC.
 2. Three-Phase, Wye:
 - a. Input: 240 VAC 3 phase; Output - 0 to 280 VAC.
 - b. Input: 480 VAC 3 phase; Output - 0 to 560 VAC.

2.10 EXHAUST BLOWERS

- A. Dedicated exhaust blower at each fume hood indicated to be individually exhausted, of airflow capacity recommended by fume hood manufacturer.
 1. Type: Direct drive.
 2. Materials: Epoxy-coated steel.
 3. Controls: On/Off using Fan switch located on fume hood post.
 4. Model selection coordinated with building electrical services.
 5. Model selection coordinated with expected static pressure losses in exhaust ductwork.

2.11 SOURCE QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory testing of each type of fume hood.
- C. Non-Complying Work: See Section 01 40 00 - Quality Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- C. Comply with indicated requirements for installing water and laboratory gas service fittings, and electrical and telecommunications devices.
 1. Install fittings in accordance with shop drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted

fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods.

D. Exhaust Blowers:

1. Turn over to appropriate trade contractor(s) for installation.

3.3 FIELD QUALITY CONTROL

A. Field test fume hoods as specified below.

1. General: Test fume hoods as installed to assess airflow velocity. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for _____ hoods provided in the Project.
2. Preparation:
 - a. Inspect each fume hood to confirm its installation complies with drawings and specifications.
 - b. Inspect laboratory space to verify that construction complies with drawings and specified requirements.
 - c. Do not proceed with fume hood testing until an acceptable TAB report has been received.
 - d. Verify that proper temperature and pressurization of the lab space can be maintained, with door(s) to the space in closed and open positions.
 - e. Adjust non-complying physical and control systems until conditions favorable to testing fume hoods are present.
3. Operating Conditions Tests:
 - a. Conduct face velocity tests to confirm that target velocities are being achieved within acceptable tolerances.
 - b. Conduct airflow indicator/monitor tests to confirm acceptable variation from corresponding measured value. Calibrate and adjust device to function within specified accuracy parameters.
 - c. Conduct exhaust flow and static pressure tests of the HVAC system and its controls to confirm flow volume and static pressures are within acceptable tolerances.
 - d. In projects with VAV lab ventilation systems, conduct response time and stability tests to confirm how the HVAC supply and exhaust systems respond to different sash opening positions.
 - e. Conduct tests of alarm device by shutting off the fume hood exhaust and verify that the individual fume hood alarm activates and operates in specified manner.
 - f. Conduct tests of individual controls provided at the fume hood (such as unoccupied cycle override, alarm override, etc.) to verify they operate in specified manner.
4. Containment Performance Tests:
 - a. Conduct airflow visualization tests (local smoke challenges) to provide a visual indication of fume hood's capture performance.
 - 1) Coordinate disabling of local fire alarm system when performing this test.
 - 2) Compensate for smoke discharge velocity and exposure outside of the fume hood.
 - 3) If required to be performed, do not proceed with the large volume challenge test if the hood has failed the local challenge test.
 - 4) Record a video of the test(s).
 - b. Conduct tracer gas containment tests, using mannequins to confirm gas concentrations meet (are below) specified criteria.
 - 1) Use tracer gas agreed-upon with Owner.

B. Field test installed fume hoods in accordance with requirements of Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

C. Reporting Requirements: Comply with Section 5 of NEBB Fume Hood Testing (FHT) Standard, current edition. Organize and include, at a minimum, the following information:

1. Report title.
2. Report certification.
3. Table of contents.
4. Report summary/remarks.
5. Appropriate forms.
6. Instrument calibration.
7. List of abbreviations used.
8. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

3.4 ADJUSTING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand only. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

3.5 CLEANING

- A. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.6 DEMONSTRATION

- A. Demonstrate proper operation of fume hoods and their accessories to Owner's designated representative.

END OF SECTION 11 53 13

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SECTION 11 70 00 - HEALTHCARE EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes: Requirements including, but not limited to, the following:
 - 1. Section includes medical equipment; connection to utilities; and service fittings and outlets.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, in size illustrating color and finish.
- E. Manufacturer's Installation Instructions: Submit special installation requirements.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 "Execution": Closeout procedures.
- B. Project Record Documents: Record actual locations of concealed utility connections.
- C. Operation and Maintenance Data: Submit description of equipment operation, adjusting, and testing required. Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- D. Warranty: Submit Manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 COORDINATION

- A. Section 01 31 00 "Project Management and Coordination": Coordination and project conditions.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

- A. Refer to Section 01 81 13 "Sustainable Design Requirements" for requirements related to the following:
 - 1. Recycled content.
 - 2. Certified Wood.
 - 3. VOC limits of adhesives.
 - 4. VOC limits of sealants.
 - 5. VOC limits of paints and coatings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.

- B. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.
- C. Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

1.9 WARRANTY

- A. Section 01 73 00 "Execution": Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for medical equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Blickman, Inc.
 - 2. Hill-Rom
 - 3. Modular Services Company.
 - 4. Welch Allyn.

2.2 MEDICAL EQUIPMENT

- A. IV Stand
 - 1. Style: 5-Leg, 4-Hook with adjustable height.
 - 2. Height adjustment: 52-1/2 inches to 93-1/2 inches.
 - 3. Finish: Chrome.
 - 4. Castors: Twin, hooded casters.
 - 5. Basis of Design: Model 1315-4 as manufactured by Blickman, Inc.
- B. Headwall
 - 1. Recessed, wall mounted.
 - 2. Profile Unit, single sided.
 - 3. Constructed of .094" thick 6063-T5 alloy, continuous extruded aluminum.
 - 4. Powder coated finish.
 - 5. 16 gauge steel backbox housing.
 - 6. Basis of Design: Model #7011 as manufactured by Modular Services Company.
- C. Portable Sink
 - 1. Basis of Design: Provide Model: ADAVM-LM-SS1DN as manufactured by Ozark River Manufacturing Co.
- D. Sharps Container Bin
 - 1. Basis of Design: Provide S-15308 as manufactured by Uline, Inc.
- E. Vital Monitor Stand
 - 1. OFOI.
- F. Spill Control Center
 - 1. Basis of Design: Provide AP6448 as manufactured by Flinn Scientific.
- G. Broken Glass Disposal Box
 - 1. Basis of Design: Provide AP8829 - Glass Disposal Container, Benchtop Model as manufactured by Flinn Scientific.

2.3 COMPONENTS

- A. Equipment: Refer to Schedule on drawings.
- B. Rough-in: Frames, anchors, supports, accessories and closure trim; appropriate to scheduled equipment.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Division 26 for wiring connections and requirements for electrical characteristics.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 "Project Coordination": Coordination and project conditions.
- B. Verify rough-in frames, anchors and supports are accurately placed.

3.2 PREPARATION

- A. Coordinate rough-in frame and anchor placement.

3.3 INSTALLATION

- A. Install in accordance with standards required by authority having jurisdiction.
- B. Anchor equipment securely in place.
- C. Sequence installation to accommodate required utility connections.
- D. Touch-up minor damaged surfaces caused during installation. Replace damaged components.

3.4 ADJUSTING

- A. Section 01 73 00 "Execution": Testing, adjusting, and balancing.
- B. Adjust operating equipment to efficient operation.

END OF SECTION 11 70 00

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SECTION 11 81 29 - FACILITY FALL PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof anchors.
 - 2. Horizontal lifeline systems.
 - 3. Ladder safety systems.
 - 4. Climbing Ladder Fall Arrest System
 - 5. Ladder safety posts.
 - 6. Safety railings and gates.
- B. Related Sections:
 - 1. Section 05 52 00 - Metal Railings: Shop-fabricated safety railings and gates.

1.3 ABBREVIATIONS AND ACRONYMS

- A. HLL: Horizontal Lifeline.
- B. IWCA: International Window Cleaning Association.
- C. RDS: Rope Descent System.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Anchorage.
 - 2. Anchorage Connector.
 - 3. Fall Arrest System.
 - 4. Fall Protection System.
 - 5. Fall Restraint System.
 - 6. Lifeline.

1.5 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. 29 CFR 1910.23 - Ladders; Current Edition.
- C. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems; Current Edition.
- D. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- E. 29 CFR 1910.140 - Personal fall protection systems; Current Edition.
- F. 29 CFR 1910.66 - Powered Platforms for Building Maintenance; Current Edition.
- G. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- H. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- I. 29 CFR 1926.1053 - Ladders; Current Edition.
- J. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- K. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).
- L. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

- M. ANSI/ASSP A10.32 - Personal Fall Protection Used in Construction and Demolition Operations; 2012.
- N. ANSI/ASSP Z359.7 - Qualification and Verification Testing of Fall Protection Products; 2019.
- O. ANSI/ASSP Z359.11 - Safety Requirements for Full Body Harnesses; 2021.
- P. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems; 2019.
- Q. ANSI/ASSP Z359.15 - Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems; 2014.
- R. ANSI/ASSP Z359.16 - Safety Requirements for Climbing Ladder Fall Arrest Systems; 2016.
- S. ANSI/ASSP Z359.18 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems; 2017, with Errata (2021).
- T. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.
- U. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- V. ASME A120.1 - Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance; 2021.
- W. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2024b.
- X. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- Y. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- Z. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- AA. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- BB. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.
- CC. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- DD. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- EE. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- FF. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
- GG. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- HH. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- II. ASTM A1023/A1023M - Standard Specification for Carbon Steel Wire Ropes for General Purposes; 2021.
- JJ. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- KK. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- LL. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications; 2021.

- MM. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- NN. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- OO. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- PP. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- QQ. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- RR. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- SS. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- TT. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- UU. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- VV. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).
- WW. CAL (OSHA) TITLE 8 SC 7 - California Code of Regulations, Title 8, Subchapter 7, General Industry Safety Orders; 2021.
- XX. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- YY. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- ZZ. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.
- AAA. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- BBB. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- CCC. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of roof anchors with roofing manufacturer to verify installation will result in a warrantable building envelope.

1.7 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's data sheets on each ladder safety system product to be used, including installation instructions.
 - 2. Material, equipment, and fixture lists. Manufacturer's catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that product complies with contract requirements. Equipment and performance data including but not limited to lifeline anchors, safety tieback anchors, and lifeline cable.
- C. Shop Drawings:
 - 1. Installation drawings showing locations and types of anchorage points for personal fall protection systems and building maintenance equipment.

2. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordination requirements with roof membrane system.
3. Indicate anchorage details and quantity, diameter, and depth of penetration of anchors.
- D. Certificates:
 1. Certify that products of this Section meet or exceed specified requirements.
 2. Certify compatibility of all products installed under this Section with roofing system.
- E. Delegated Design Documents: Drawings and calculations sealed by Designer for fall protection system, indicating compliance with performance requirements and design criteria.
- F. Test Report: Indicating completion of proof load testing on installed systems.
- G. Manufacturer's Installation Instructions: Instructions indicating recommended method and sequence of installation for lifeline anchors, safety tieback anchors, energy-absorbing devices, and lifeline cable.
- H. Designer's qualification statement.
- I. Manufacturer's qualification statement.
- J. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- K. Installer's qualification statement.
- L. Testing agency's qualification statement.
- M. Operation Data: Provide operating instructions and identify unit limitations.
- N. Maintenance Data: Include parts list and maintenance requirements for equipment.

1.8 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Roof Anchors:
 - a. Guardian Fall Protection: www.guardianfall.com.
 - b. Pro-Bel Enterprises Ltd: www.pro-bel.ca.
 - c. Summit Anchor Company: www.summitanchor.com.
 2. Horizontal Lifeline Systems:

3. Climbing Ladder Fall Arrest Systems (CLFAS):
 4. Ladder Safety Post:
 5. Ladder Safety System:
 6. Personal Fall Arrest System:
 7. Permanent Safety Railings:
 8. Non-Penetrating Safety Railings:
 - a. Kee Safety, Inc: www.keesafety.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 3. Fire Code:
 - a. Comply with applicable requirements of International Fire Code ICC (IFC).
 4. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 ROOF ANCHORS

- A. Application:
- B. Description:
1. Roof anchorage points for personal fall protection systems; used exclusively for employee fall protection and independent of any anchorage used to suspend employees or platforms on which employees work.
 - a. Anchor Type per ANSI/ASSP Z359.18: Type T.
 2. Roof anchorage points for primary suspension lines for bosun's chairs, work cages, and suspended platforms used for window washing or facade access.
- C. Structural Performance: Provide safety tieback anchors capable of withstanding design loads as required by governing regulations and codes.
- D. Design Criteria: Fall protection anchors.
1. Comply with 29 CFR 1910.140 and 29 CFR 1926.502 for personal fall protection systems and anchorage.
 2. Comply with 29 CFR 1926, Subpart M-Fall Protection.
 3. Comply with ANSI/ASSP Z359.18 test requirements for static strength, dynamic strength, residual strength, serviceability, and corrosion of anchorage.
 - a. Testing Labs: Meet requirements of ANSI/ASSP Z359.7 and ISO/IEC 17025.
 4. Comply with CAL (OSHA) TITLE 8 SC 7 requirements for anchors used in personal fall protection systems.
- E. Design Criteria: Primary suspension lines.
1. Comply with 29 CFR 1910.27 for RDS anchorage requirements.
 2. Comply with 29 CFR 1910.140 for fall protection.
 3. Comply with 29 CFR 1926, Subpart M-Fall Protection.

4. Comply with ANSI/IWCA I-14 requirements for anchors used in window washing applications.
 5. Comply with CAL (OSHA) TITLE 8 SC 7 requirements for anchors used in window washing applications.
 6. Comply with ASME A120.1 requirements for anchors for powered platforms.
- F. Provide permanent labels with manufacturer's name, serial number, manufacturing date, and rated load on roof anchors.
- G. Anchors:
1. Type: Vertical foam-filled steel pier and baseplate with galvanized forged steel loop.
 - a. Loop Diameter: 1-3/8 inch (35 mm).
 - b. Pier:
 - 1) Height: 12 inches (305 mm).
 - 2) Diameter: 3-inch (76-mm) OD.
 - 3) Wall Thickness: Schedule 40.
 - 4) Material: Hot-dip galvanized steel pipe.
 - 5) Foam: Polyurethane. ASTM E84 Class I.
 - 6) Threaded vent hole with stainless steel plug.
- H. Anchor Installation:
1. Type: Cast-in-place.
 2. Anchor Substrate: Existing concrete deck.
 3. Roofing Material: As indicated on drawings.
 4. Flashing Material: Premolded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

2.4 HORIZONTAL LIFELINE SYSTEMS

- A. Description: A system comprised of a flexible line such as wire rope or cable, with connectors at both ends to secure it horizontally between two anchorages or anchorage connectors.
- B. Structural Performance: Provide fall-arresting lifeline systems capable of withstanding design loads as required by governing regulations and codes.
- C. Design Criteria:
1. Comply with ANSI/ASSP Z359.12.
 2. Comply with ANSI/ASSP Z359.15.
 3. Comply with 29 CFR 1926.502.
 4. Comply with ANSI/ASSP A10.32.
- D. Wire Rope: ASTM A1023/A1023M, 7x7 galvanized wire , 5/16 inch (8 mm) diameter.
1. Stainless Steel Rigging Components: Consisting of turnbuckles, cable clamps, spring energy absorbers, absorber couplers, eye thimbles, bolts, and connector O-rings as required to make a complete and functional HLL system compatible with installed anchors.

2.5 LADDER SAFETY SYSTEMS

- A. Climbing Ladder Fall Arrest System (CLFAS):
1. Description: Climbing ladder fall arrest system allows worker to climb up and down using both hands; does not require employee continuously, hold, push, or pull any part of system while climbing.
 2. Comply with 29 CFR 1910.29, 29 CFR 1926.1053, Section 7 of ANSI A14.3 and ANSI/ASSP Z359.16.
 3. Install on new fixed ladders over 24 feet (7315 mm) in height.
 4. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.

5. Flexible Carrier: Fixed 3/8-inch (9.5 mm) diameter stainless steel wire rope lifeline with shock absorber and top, bottom, and intermediate supports, meeting requirements of ANSI/ASSP Z359.16.
 - a. Provide with stainless steel extension post at top of ladder, meeting requirements of ANSI/ASSP Z359.16.
 6. Rigid Carrier: Fixed 304 stainless steel U-shaped slotted track with top, bottom, and intermediate supports, meeting requirements of ANSI/ASSP Z359.16.
 - a. Provide with stainless steel extension post at top of ladder, meeting requirements of ANSI/ASSP Z359.16.
 7. Fall Arrester: Stainless steel and aluminum automatic pass-through carrier sleeve fall arrester meeting requirements of ANSI/ASSP Z359.15 and ANSI/ASSP Z359.16; compatible with carrier.
 - a. If designed to be removable from carrier, arrester removable only by at least two deliberate manual action(s) by user.
 - b. Includes an anti-inversion device to prevent installation of carrier sleeve upside down on carrier.
 - c. Carrier sleeve movement is automatic and does not require continuous manual intervention during climbing or descending.
 - d. Includes panic grab (secondary locking mechanism) feature.
- B. Ladder Safety Post:
1. Basis of Design:
 2. Furnish and install where indicated on Drawings. The ladder safety post shall be pre-assembled from the manufacturer.
 3. Performance Characteristics:
 - a. Tubular post shall lock automatically when fully extended.
 - b. Safety post shall have controlled upward and downward movement.
 - c. Release lever shall disengage the post to allow it to be returned to its lowered position.
 - d. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14 inches (356 mm) on center and clamp brackets to accommodate ladder rungs up to 1-3/4 inch (44 mm) in diameter.
 4. Post: Shall be manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
 5. Material:
 6. Balancing Spring:
 - a. A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post.
 7. Hardware: All mounting hardware shall be Type 316 stainless steel.
 8. Finishes:
- C. Ladder Safety System:
1. Description: Ladder safety system allows the worker to climb up and down using both hands; does not require the employee continuously, hold, push, or pull any part of the system while climbing.
 2. Comply with 29 CFR 1910.29, 29 CFR 1926.1053, and Section 7 of ANSI A14.3.
 3. Install on new fixed ladders over 24 feet (7315 mm) in height.
 4. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.
 5. Flexible Carrier: Fixed 3/8-inch (9.5 mm) diameter stainless steel wire rope lifeline with shock absorber and top, bottom, and intermediate supports.
 - a. Provide with stainless steel extension post at top of ladder.
 6. Rigid Carrier: Fixed 304 stainless steel U-shaped slotted track with top, bottom and intermediate supports.

- a. Provide with stainless steel extension post at top of ladder.
- 7. Fall Arrester: Stainless steel automatic pass-through carrier sleeve fall arrester; compatible with carrier.
- D. Personal Fall Arrest System Components; 29 CFR 1910.140:
 - 1. Comply with 29 CFR 1910.140.
 - 2. Body Support: Full body harness meeting requirements of ANSI/ASSP Z359.11; equipped with front or hip D-rings for attachment to climbing ladder fall arrest system.
 - 3. Connecting Means: Connecting hardware, such as a locking carabiner, meeting requirements of ANSI/ASSP Z359.12; compatible with fall arrester and body support harness.

2.6 PERMANENT SAFETY RAILINGS AND GATES

- A. Basis of Design:
- B. Steel or Aluminum Safety Railings and Gates: Refer to Section 05 52 00 - Metal Railings.
- C. Design Criteria:
 - 1. Railing: Comply with 29 CFR 1910.29 and 29 CFR 1926.502 for fall protection.
 - 2. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable regulations.
 - 3. Distributed Loads: Design railing assembly and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
 - 4. Concentrated Loads: Design railing assembly and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Railing Dimensions: Refer to Drawings for configurations and heights.
 - 1. Top Rails: 1-1/2-inch (38 mm) diameter, round.
 - 2. Intermediate Rails: 1-1/2-inch (38 mm) diameter, round.
 - 3. Posts: 1-1/2-inch (38 mm) diameter, round.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable, provide flush countersunk fasteners.
 - 1. Posts: Provide adjustable flanged brackets.
 - 2. Surface Mounting Bases: Provide zip bases.
- F. Posts and Rails: Galvanized steel tubing.
- G. Gate: Same material as railing; automatic closing with latch.
- H. Finish: Manufacturer's standard, factory-applied finish.

2.7 NON-PENETRATING SAFETY RAILINGS

- A. Basis of Design:
 - 1. Kee Guard Safety Rail manufactured by Kee Safety, Inc.
- B. Design Criteria:
 - 1. Railing: Comply with 29 CFR 1910.29 and 29 CFR 1926.502 for fall protection.
 - 2. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable regulations.
 - 3. Distributed Loads: Design railing assembly and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
 - 4. Concentrated Loads: Design railing assembly and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

- C. Railing Dimensions: Refer to Drawings for configurations and heights.
 - 1. Top Rails: 1-1/4 inch (32 mm) diameter, round.
 - 2. Intermediate Rails: 1-1/4 inch (32 mm) diameter, round.
 - 3. Posts: 1-1/4 inch (32 mm) diameter, round.
- D. Roof Edge Protection: Provide freestanding KeeGuard Roof Edge Protection System, including pipe railings, uprights, bases, counterweights and fittings
 - 1. Freestanding counterweighted guardrail system with 42 inch (1,067 mm) minimum height to provide a pedestrian egress barrier on the roof to withstand a minimum load of 200 lbf (890 N) in any direction to the top rail per OSHA Regulation 29 CFR 1910.23.
 - 2. Pipe: Steel, 1-1/4 inch (32 mm) schedule 40, galvanized.
 - 3. Tube: Galvanized tube, 12 gauge, 1-1/2 inch (38 mm), 1.90 inch (48 mm) OD
 - 4. Rails and Posts: Galvanized Tube, 12 gauge, 1-1/4 inch (32 mm) diameter.
 - 5. Counterweight Levers: Galvanized Tube, 12 gauge, 1-1/4 inch (32 mm) diameter.
 - 6. Mounting Bases: Steel bases are galvanized and are supplied with a rubber pad on underside of the component.
 - 7. Counterweights: Molded recycled PVC with one fixing collar per counterbalance.
 - 8. Fasteners: Stainless steel or galvanized.
- E. Provide slip-on, non-welded mechanical fittings to join lengths, seal open ends including, but not limited to, elbows, crossovers, T-shapes, and splice connectors.
- F. Posts and Rails: Galvanized steel pipe and tube.
- G. Finish: Manufacturer's standard, polyester, factory-applied finish.
 - 1. Color: As selected by Architect from manufacturer's full line.

2.8 MATERIALS - ALUMINUM

- A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
- B. Aluminum Tube: Minimum wall thickness of 0.127 inch (3.2 mm); ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
- C. Aluminum Non-Welded Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush set screws for tightening by standard hex wrench, no bolts or screw fasteners.
- D. Aluminum Welded Fittings: No exposed fasteners; cast aluminum.
- E. Aluminum Straight Splice Connectors: Concealed spigot; cast aluminum.
- F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.9 MATERIALS - STEEL

- A. Structural Steel Sections: ASTM A36/A36M.
- B. Steel Plates, Shapes, and Bars: ASTM A6/A6M or ASTM A283/A283M.
- C. Steel Pipe: ASTM A53/A53M Grade B Schedule 40.
- D. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized in accordance with ASTM A153/A153M where connecting galvanized hardware components.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.10 MATERIALS - STAINLESS STEEL

- A. Stainless Steel, General: ASTM A666, Type 304.
- B. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625-inch (1.59 mm) minimum metal thickness, 1-1/2-inch (38 mm) diameter.
- C. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- D. Welding Materials: AWS D1.6/D1.6M; type required for materials being welded.

2.11 FABRICATION

- A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.
- B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.
- C. Fabricate system components of the same material unless otherwise indicated.
- D. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.
- E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain all water that could accumulate in the exposed joints.

2.12 FINISHES

- A. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.
- B. Stainless Steel: #4 brushed finish, unless noted otherwise.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine area for compliance with requirements for installation tolerances and other conditions related to this work.
- B. Confirm that the ladder structure to which the ladder safety system is installed can withstand the loads applied by the system in the event of a fall.
- C. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate location of fall protection equipment indicated to be attached to structural substrate or surface of roofing system and provide anchoring devices with templates, diagrams, and installation instructions.

3.3 INSTALLATION

- A. Install anchorage and fasteners in accordance with shop drawings and manufacturer's recommendations to obtain allowable working loads published in product literature and in accordance with this specification.
- B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous coating or by other permanent separation as recommended by fall protection system manufacturer.
- C. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- D. Do not load or stress anchors until all materials and fasteners are properly installed and ready for service.
- E. Seal roof penetrations at anchors with pre-molded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

- F. Install all roof safety anchors a minimum of 6 feet (1.83 m) from the roof edge.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Test anchorage systems using only chemical adhesive fasteners on-site using load cell test apparatus in accordance with manufacturer's recommendations.
- C. Load test anchors under the direct supervision of a licensed engineer in accordance with ACI 318, AISC 360, ASCE 7, ICC (IBC), 29 CFR 1910.27, and 29 CFR 1910.66 requirements.
- D. Inspect each anchor for conformance to manufacturer requirements, building envelope, looseness, and signs of permanent deflection during load testing.

3.5 ADJUSTING

- A. Adjust fall protection components to function smoothly and safely.

3.6 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
- C. Clean exposed surfaces in accordance with fall protection system manufacturer's written instructions.

3.7 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate operation of equipment to the Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- D. Training: Train the Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.

3.8 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. 29 CFR 1910 and ANSI/IWCA I-14 require that anchors first be certified and subsequently inspected on an annual basis. Coordinate with manufacturer and local inspectors as required to maintain compliance.
- C. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION 11 81 29

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SECTION 11 90 00 - MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall-mounted gas cylinder brackets.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking.

1.2 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2025a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024.
- J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; and point loads.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and installation and servicing clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, a minimum of 6 by 6 inches (150 by 150 mm) in size illustrating color and finish.

- E. Operation Data: Include description of equipment operation and required adjusting and testing .
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
 - 1. fischer scientific, Part of Thermo Fisher Scientific: www.fischersci.com.
 - 2. Labconco Corporation: www.labconco.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 EQUIPMENT

- A. General Conditions:
 - 1. Prewire and prepipe each unit of equipment complete with trim and fittings. Include reduced pressure or atmospheric type backflow preventer fitting to prevent backflow of polluted water or waste into water supply system or equipment. Comply with applicable code requirements.
 - 2. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.
 - 3. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.
 - 4. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item.
- B. Gas Cylinder Support Bracket:
 - 1. Basis of Design: Justrite Gas Cylinder Support Bracket manufacturer by fisher scientific.
 - 2. Capacity: 2 cylinders, 4 to 12 inch diameter each.
 - 3. Material: Steel.

4. Finish: Powder-coat.
 - a. Color: Gray.
5. Accessories:
 - a. Polymer protective edging.
 - b. Support chain.
6. Mounting: Wall.

2.3 MATERIALS

- A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
 1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.
- D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: ASTM C1172.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide rough-in frame and anchors for placement by Section 01 25 13 - Product Substitution Procedures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
 1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.
 1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.
 2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified

for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.

3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.5 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.6 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Owner. Replace any parts that cannot be repaired in such a manner.

END OF SECTION 11 90 00

SECTION 12 11 13 - PHOTO MURALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.
- B. Product Data:
 - 1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements.
 - 2. Manufacturer's written preparation, installation, and cleaning and maintenance instructions and recommendations.
- C. Samples:
 - 1. Color Approval Proof:
 - a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
 - b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.
- D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

- A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

1.6 WARRANTY

- A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlaminate from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

- A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers

must have a minimum of five (5) years experience supplying (and for graphics providers, installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

2.2 GRAPHICS PROVIDER

- A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; dana.lapointe@riotcolor.com; www.riotcolor.com
- B. Other Approved Manufacturer: Mountain Commercial Graphics; (713) 996-6634.
- C. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

2.3 EQUIPMENT

- A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.
- B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlaminate.

2.4 MATERIALS

- A. Basis of Design for VWC-Drywall Application:
- B. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
 - 1. Colorfastness: Greater than or equal to 200h.
 - 2. Washability: Greater than or equal to 100 cycles.
 - 3. Scrubbability: Greater than or equal to 300 cycles.
 - 4. Abrasion Resistance: Greater than or equal to 300 cycles.
 - 5. Cracking, Drying: Good.
 - 6. Stain Resistance to Reagents: 4.
 - 7. Flame Spread: Less than or equal to 25.
- C. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
 - 1. Curing: Heat and infrared cured.
 - 2. VOCs: Less than 294 g/L.
 - 3. Hazardous Air Pollutants (HAPs): None.
 - 4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
 - 5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C.
- D. Vinyl Wall Covering: Dreamscape Suede.
 - 1. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
 - 2. Construction: Embossed vinyl face with laminated fabric backing.
 - 3. Backing: Poly-cotton woven or polyester/pulp non-woven.
 - 4. Type Properties: Passes all criterion for WA 101, Type II.
 - 5. Thickness: 0.017 in.
- E. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.
 - 1. Basis of Design for CMU Application:
- F. Vinyl Graphics Film: 3M™ "IJ180Cv3-10 Controllac™ Graphic Film" cast vinyl film suitable for inkjet printing. Calendered films are not acceptable.
 - 1. Film Thickness: 0.05 mm (2 mil, 0.002 inch).
 - 2. Surface: Smooth, white, opaque and glossy.

3. Applied shrinkage: < 0.1 mm per FTM 14.
4. Adhesive: Factory-applied 3M "Comply™ v3" solvent acrylic pressure-sensitive repositionable adhesive with air release channels, protected by double-sided polyethylene coated paper, for dry application only, for permanent, non-removable installation.
 - a. Adhesion: Approximately 18 N/25 mm per FTM 1 (180 degree peel, glass, 24h, 23 degrees C, 50 percent RH).
- G. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
 1. Curing: Heat and infrared cured.
 2. VOCs: Less than 294 g/L.
 3. Hazardous Air Pollutants (HAPs): None.
 4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
 5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C.
- H. Protective Laminating Film: 3M™ "Envision™ Luster Wrap Overlamine 8548L" cast film. Calendared films are not acceptable.
 1. Luster high performance non-PVC film.
 2. Exceptional conformability and lifting resistance.
 3. Less prone to scratching.
 4. Superior UV and acid dew protection.
 5. Longer term vertical durability.
 6. Horizontal warranty.

2.5 PROCESSING AND PRODUCTION

- A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.
- B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.
- C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
 1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
 2. Report unsatisfactory conditions to the Architect in writing.
 3. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.
- B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint

and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

3.3 INSTALLATION

A. Digitally-Printed Vinyl Murals:

1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.
2. Install in accordance with manufacturer's instructions and reviewed submittals.
3. Install in location(s) shown on drawings.
4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

3.4 CLEANING AND PROTECTION

- A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.
- B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.
- C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.
- D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

END OF SECTION 12 11 13

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontal slat louver blinds.
 - 2. Operating hardware.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

- A. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the placement of concealed blocking to support blinds. Refer to Section 06 10 00 - Rough Carpentry.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 6 inch (150 mm) long illustrating slat materials and finish, cord type and color.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Horizontal Louver Blinds:
 - a. Draper, Inc; www.draperinc.com.
 - b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - c. Levolor: www.levolor.com/commercial.
 - d. Springs Window Fashions (SWF)contract, a division of Springs Window Fashions, LLC: www.swfcontract.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

- C. Source Limitations: Furnish blinds and associated controls produced by a single manufacturer and obtained from a single supplier.

2.2 BLINDS WITHOUT SIDE GUIDES

- A. Basis of Design:
 - 1. Riviera One manufactured by Levolor.
- B. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail complying with WCMA A100.1.
- C. Manual Operation: Control of raising and lowering by cordless-mechanism; blade angle adjustable by control wand.
- D. Slat Support: Polymer cord, ladder configuration.
- E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
 - 1. Height: As required.
 - 2. Color: Match slats.
- F. Bottom Rail: Pre-finished, formed steel; with end caps.
 - 1. Color: Match headrail.
- G. Headrail Attachment: Wall brackets.
- H. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

- A. Determine sizes by field measurement.
- B. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch (6 mm) between blinds, located at window mullion centers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed. Refer to Section 06 10 00 - Rough Carpentry.

3.2 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.
- C. Place intermediate head supports at spacing recommended by the manufacturer.

3.3 TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (6 mm).
- B. Maximum Offset From Level: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust blinds for smooth operation.

3.5 CLEANING

- A. Clean blind surfaces just prior to occupancy.
- B. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION 12 21 13

SECTION 12 35 53.19 - WOOD LABORATORY CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Custom wood cabinets and cabinet hardware.
- B. Reagent shelving.
- C. Wall shelving.
- D. Service space framing.
- E. Acid storage cabinets.
- F. Solvent storage cabinets.
- G. Vacuum pump cabinets.
- H. Countertops.
- I. Laboratory sinks.
- J. Pegboards.

1.2 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements for sustainably harvested wood.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- C. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- E. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
- F. Section 09 65 00 - Resilient Flooring: Resilient wall base.
- G. Section 10 56 17 - Wall-Mounted Standards and Shelving.
- H. Section 12 35 53.13 - Metal Laboratory Casework: Additional requirements.
- I. Section 12 36 00 - Countertops: Additional requirements for countertops.
- J. Section 22 40 00 - Plumbing Fixtures for non-laboratory sinks.
- K. Section 22 43 00 - Healthcare Plumbing Fixtures: Additional emergency equipment.
- L. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems.
- M. Section 26 50 00 - Lighting: Task-lighting luminaires.

1.3 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following Casework definitions:
 - 1. Concealed.
 - 2. Exposed.
 - 3. Semi-Exposed

1.4 REFERENCE STANDARDS

- A. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

- E. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- J. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- K. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- N. AWI (QCP) - Quality Certification Program; Current Edition.
- O. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- P. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- Q. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- R. BHMA A156.9 - Cabinet Hardware; 2020.
- S. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.
- T. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- U. MFMA-4 - Metal Framing Standards Publication; 2004.
- V. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- W. NFPA 1 - Fire Code; 2024, with Errata.
- X. NFPA 30 - Flammable and Combustible Liquids Code; 2024, with Errata (2025).
- Y. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Z. SEFA 1 - Laboratory Fume Hoods; 2010.
- AA. SEFA 2 - Installations; 2010.
- BB. SEFA 3 - Laboratory Work Surfaces; 2020.
- CC. SEFA 7 - Laboratory Fixtures; 2021.
- DD. SEFA 8W - Laboratory Grade Wood Casework; 2020.
- EE. SEFA 11 - Liquid Chemical Storage Cabinets; 2019.
- FF. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- GG. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- HH. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of casework with related items.
 - 1. Service Fixtures: Coordinate location and characteristics of service connections.
 - 2. Equipment and Instruments: Coordinate installation of casework with equipment and scientific instruments.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware, accessories, and service fittings, if any.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
- D. Samples For Color Selection: Wood samples, fully finished, for color and species selection. Minimum Sample Size: 2 inches by 3 inches (51 mm by 75 mm).
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Test Reports: From independent laboratory indicating compliance with referenced chemical-resistance standards for cabinet finish and liner materials.
- G. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- H. Finish touch-up kit for each type and color of materials provided.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.
- C. Quality Certification:
 - 1. Provide labels or certificates indicating that installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:

1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" paragraph of this section.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
1. Ruptured, cracked, or stained finish coating.
 2. Discoloration, or lack of finish integrity.
 3. Cracking or peeling of finish.
 4. Failure of hardware.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Wood Laboratory Casework:
1. Bedcolab Ltd: www.bedcolab.com/#sle.
 2. CiF Lab Solutions LP: www.cifsolutions.com/#sle.
 3. Hamilton Laboratory Solutions: www.hamiltonlab.com/#sle.
 4. Institutional Casework Inc: www.iciscientific.com/#sle.
 5. Kewaunee Scientific Corp: www.kewaunee.com/#sle.
 6. LOC Scientific: www.locscientific.com/#sle.
 7. Mott Manufacturing: www.mott.ca/#sle.
- B. Plastic Laminate Casework:
1. Case Systems: www.casesystems.com/#sle.
 2. Labscape LLC: www.labscape.com/#sle.
 3. TMI Systems Corporation: www.tmisystems.com/#sle.
- C. Sinks and Cup Sinks:
1. Durcon (Epoxy resin, Polyolefin): www.durcon.com/#sle.
 2. Scientific Plastics, Inc. (Polyolefin): www.scientificplastics.com/#sle.
- D. Water and Gas Service Fittings:
1. Chicago Faucets, a Geberit company: www.chicagofaucets.com/#sle.
 2. WaterSaver Faucet Co: www.wsflab.com/#sle.
- E. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 WOOD LABORATORY CASEWORK

- A. Wood Laboratory Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 3. Construction: Joints doweled, glued and screwed, except drawers may be lock-shoulder jointed; with interior of units smooth and flush; cabinet bottom flush with top of face frame; without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.

4. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7, and SEFA 8W, components safely support the following minimum loads:
 - a. Base Units: 500 pounds per linear foot (744 kgs/linear m) across the cabinet ends.
 - b. Suspended Units: 300 pounds (136 kg) static load.
 - c. Tables: 300 pounds (136 kg), minimum, on four legs.
 - d. Drawers: 125 pounds (57 kg), minimum.
 - e. Hanging Wall Cases: 300 pounds (135 kg).
 - f. Shelves: 100 pounds (45 kg), minimum.
5. Glazing: Type and thickness standard with manufacturer.
 - a. Framed Doors: Float glass, with gaskets and removable stops; minimize rattling and vibration.
 - b. Frameless Doors: Float glass.
 - 1) Flat polished and chamfered edges.
6. Fittings and Fixture Locations: Cut and drill counter tops, backs, and other components for service outlets and fixtures.
7. Access Panels: Where indicated, for maintenance of utility service and mechanical and electrical components.
8. Removable back panels on base cabinets. Provide partial height back panels at sink cabinets.
9. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
10. Factory-finish all exposed and semi-exposed surfaces with the same finish.
 - a. Finish Performance: Provide finish on all surfaces having chemical resistance of Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8W and no visible effect when surface is exposed to:
 - 1) Hot water at temperature between 190 degrees F (88 degrees C) and 205 degrees F (96 degrees C) trickled down the test surface at 45 degree angle for 5 minutes.
 - 2) Constant moisture in the form of 2 by 3 by 1 inch (51 by 76 by 25 mm) thick cellulose sponge kept continually saturated with water and in contact with test surface for 100 hours.
 - b. Preparation: Wood sanded smooth, free from dust and mill marks.
 - c. Stain: Single application of clean, manufacturer-recommended stain of selected color; tinted coating not acceptable.
 - d. Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
 - e. Coats: Multiple coats as required to achieve minimum 1.5 mil (0.038 mm) dry film thickness.
 - f. Appearance: Clear satin gloss; not cloudy or muddy.
- B. Reagent Shelving and Supports.
 1. Shelves: 3/4 inch (19 mm) thick epoxy resin shelves in lengths indicated.
 - a. Depth: 12 inches (305 mm).
 2. Supports: Manufacturer's standard metal support pedestal assemblies.
- C. Acid Storage Cabinets: Construction identical to other cabinets, with following exceptions:
 1. Completely lined with corrosion-resistant liner material; stainless steel fasteners for all connections and hardware inside cabinets.
 2. Shelves: Removable, same material as cabinet, covered with corrosion-resistant liner.
 3. Bottom Pan: Liquid-tight liner covering entire bottom of acid-storage cabinet.
- D. Solvent (Flammable and Combustible Liquids) Storage Cabinets: Construction identical to other cabinets, with following exceptions:
 1. Construct to NFPA 30 and applicable OSHA requirements.

2. Fire Resistance: Maximum internal temperature of 325 degrees F (163 degrees C) at the center, and 1 inch (25.4 mm) from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in ASTM E119.
3. Shelves: Full depth, adjustable.
4. Bottom Pan: 2 inches (50.8 mm) deep, liquid-tight pan covering entire bottom of cabinet.
5. Cabinet Hardware: UL-listed.
 - a. Hinges: Full-length stainless steel continuous (piano) hinges.
 - b. Door Handles: Manufacturer's standard, with slip-resistant grip.
6. Vents: Provide venting capable of achieving ten air changes per hour.
 - a. Tie into building hazardous exhaust system.
 - b. Vent Connections: 1-1/2 inch (38 mm) minimum diameter, corrosion-resistant piping having flame spread index of 25 or less when tested in accordance with ASTM E84.
 - c. Vent each cabinet separately with sufficient mixing distance for incompatible chemicals.
 - d. Provide minimum of two vents with fire arrestor for each cabinet.
7. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.

2.3 CABINET HARDWARE

- A. Manufacturer's standard types, styles, and finishes.
- B. Comply with BHMA A156.9 requirements.
- C. Finish of exposed stainless steel components: No.4 finish.
- D. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
- E. Label Holders: Manufacturer's standard, sized to hold standard label cards for drawer fronts and cabinet doors indicated, stainless steel with No.4 finish.
- F. Shelves in Cabinets:
 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- G. Wall-Mounted Shelving:
 1. Shelf Brackets: Vertical chrome steel standards with chrome steel arms.
- H. Swinging Doors:
 1. Hinges: Offset pin, number as required by referenced standards for width, height, and weight of door.
 2. Catches: Magnetic.
 3. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 4. Drawers:
 - a. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 - b. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.4 COUNTERTOPS

- A. Countertops: Refer to Section 12 36 00 - Countertops.

2.5 SINKS

- A. Laboratory sinks.
 1. General: Manufacturer's adjustable support system for undermount sink installation.
 2. Sink types and sizes are indicated on drawings.

2.6 PEGBOARDS

- A. Epoxy pegboards with pre-drilled or punched holes in a staggered pattern, designed to accept removable white polypropylene pegs. With each pegboard include a stainless steel drip-trough with drain outlet and matching diameter 36 inches (914 mm) long PVC drain hose.
 - 1. Size: 30 inches wide by 30 inches high (762 mm wide by 762 mm high).
 - 2. Accessories: Screen insert.

2.7 SERVICE SPACE FRAMING

- A. Support Framing Units: Galvanized steel framing units at space between back-to-back cabinets and between backs of cabinets and wall surfaces.
 - 1. Manufacturer's standard assemblies.

2.8 MATERIALS

- A. Wood-Based Materials:
 - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
 - 2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.
- B. Exposed Solid Wood: Clear, dry, sound, plain sawn, selected for compatible grain and color, no defects.
- C. Exposed Hardwood Plywood: Veneer core; HPVA HP-1 Grade AA, Type I; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.
- D. Solid Epoxy Resin: Modified epoxy resin and non-asbestos inert fillers cast into sheets.
- E. Glass: Fully tempered float; ASTM C1036, Type 1, Quality Q3; ASTM C1048, tempered using horizontal tempering and complying with ANSI Z97.1; 3/16 inch (4.5 mm) thick minimum; exposed edges ground, and cut or drilled to receive hardware; clear.
- F. Solvent-Resistant Liner Material: High-density, asbestos-free, non-combustible, calcium-silicate-based panel consisting of autoclaved Portland cement, mineral fillers and synthetic fibers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

3.2 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- C. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- D. Set casework items plumb and square, securely anchored to building structure.

1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch (19 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
2. Wall Cabinets: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 - a. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more, and/or maximum variation from plumb exceeds 1/4 inch (6 mm) per story.
 - b. Maximum Variation of finished gypsum board surface from true flatness exceeds 1/8 inch in 10 feet (3 mm in 3 m) in any direction.
- E. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- F. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
 1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch (3 mm) in 10 feet (3 m).
 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).
- G. Secure upper and floor cabinets to concealed reinforcement at gypsum board assemblies.
- H. Separate dissimilar metals to prevent galvanic action.
- I. Service Space Framing: Anchor to floor with two fasteners at each frame. Fasten to wall substrates.
- J. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches (610 mm) on center, and at sides of cabinets with not less than two fasteners per side.
- K. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches (407 mm) on center.
- L. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- M. Vented Cabinets: Install in strict compliance with manufacturer's written installation instructions.
 1. Install vent kits and connect to fume hood exhaust system.
 2. Use only rigid materials for venting. No flexible materials permitted.
 3. Plug vent openings in unvented cabinets with manufacturer's standard closure.
- N. Coordinate installation of work of this section with installation of fume hoods and laboratory equipment.
- O. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.
- P. Deliver sinks, cup sinks, and service fittings in properly marked boxes, accompanied with written instructions, for supervised installation by appropriate trade contractor(s).
- Q. Replace units that are damaged, including those that have damaged finishes.

3.3 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.4 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

3.5 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 12 35 53.19

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SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Countertops for architectural cabinet work.
 - 2. Wall-hung counters and vanity tops.
 - 3. Countertop supports.
- B. Related Sections:
 - 1. Section 11 53 13 - Laboratory Fume Hoods: Work surfaces inside fume hoods.
 - 2. Section 12 35 53.13 - Metal Laboratory Casework: Laboratory countertops.
 - 3. Section 12 35 53.19 - Wood Laboratory Casework: Laboratory countertops.
 - 4. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- G. AWI (QCP) - Quality Certification Program; Current Edition.
- H. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- I. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- M. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- O. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- P. NSF 51 - Food Equipment Materials; 2023.
- Q. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- R. PS 1 - Structural Plywood; 2023.
- S. SEFA 2 - Installations; 2010.
- T. SEFA 3 - Laboratory Work Surfaces; 2020.

- U. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- V. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- W. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.4 PERFORMANCE REQUIREMENTS

- A. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
 - 1. All deadloads.
 - 2. 500 pound live load placed on the countertop and vanity.
 - 3. Deflection at Midspan: $L/1000$ times span or 1/8 inch (3 mm) whichever is less.
- B. WI Premium Grade: Where indicated on Drawings.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- H. Installer's qualification statement.
- I. Installation Instructions: Manufacturer's installation instructions and recommendations.
- J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com.
 - 4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 5. Provide designated labels on shop drawings as required by certification program.

6. Provide designated labels on installed products as required by certification program.
7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 1. Rough or difficult operation, or loose or missing parts.
 2. Delamination of surfaces.
 3. Noticeable deterioration of finish.
 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Manufacturers listed for products in this Section.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 COUNTERTOPS

- A. General:
 1. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 2. Quality Standard: SEFA 3 for laboratory worksurfaces.
- B. Phenolic Resin Sheet:
 1. Comply with SEFA 3 performance requirements for laboratory work surfaces. Material: Thermosetting phenolic resin, integrally fused with mineral fillers and pigments; homogeneous, non-porous, resistant to chemicals, heat, and moisture. Machinable with carbide or diamond tooling; no applied surface coating; color and pattern consistent throughout thickness.
 2. Basis of Design Products:
 - a. Products manufactured by Fundermax, or approved equal.
 - b. Flat Sheet Thickness:
 - 1) 3/4 inch (19 mm), minimum, 1 inch (25 mm) where indicated.
 - c. Surface Burning Characteristics:
 - 1) Flame spread index: 25, maximum. Smoke developed index: 450, maximum. Tested in accordance with ASTM E84.

- d. Chemical Resistance:
 - 1) Surfaces shall withstand exposure to acids, alkalis, solvents, and reagents typically found in laboratory use; tested in accordance with SEFA 3.
- e. FLaboratory Certification:
 - 1) SEFA approved for laboratory applications and resistant to biological and chemical contaminants.
- f. Finish on Exposed Surfaces:
 - 1) Matte or satin, low-sheen finish.
- g. Color and Pattern:
 - 1) PRC: As indicated on Drawings.
- 3. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick, unless otherwise indicated. Edge profiles: Chamfer.
- 4. Back and End Splashes: Same phenolic resin material; minimum 4 inches (102 mm) high. Separate splash sections with square top.
- 5. Skirts: As indicated on Drawings.
- 6. Fabrication Standards: Fabricate in accordance with SEFA 3 guidelines and manufacturer's published standards.
- 7. Accessories:
- 8. Provide cutouts, holes, and accommodations for sinks, fixtures, and service penetrations as indicated. Factory-finished edges polished smooth.
- 9. Fabrication Tolerances: In accordance with manufacturer's published standards.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Basis of Design Products:
 - 1) Products manufactured by Dupont.
 - b. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. NSF approved for food contact.
 - e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - f. Color and Pattern:
 - 1) SCT1: Modern White.
 - 2) SCT2: Deep Nocturn.
 - 2. Other Components Thickness: 1/2 inch (12 mm), minimum.
 - 3. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge, hardwood nosing.
 - 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 - 5. Skirts: As indicated on Drawings.
 - 6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
 - 7. Fabricate in accordance with manufacturer's standard requirements.

2.3 ACCESSORIES

- A. Countertop and Vanity Supports:
 - 1. Custom Fabricated Countertop and Vanity Framing:
 - a. Material: Steel

- b. Fabrication: Fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the work.
 - c. Finish: Powder Coat.
 - 1) Color: Black.
 - 2. Pre-Fabricated Countertop and Vanity Supports:
 - a. Material: Aluminum.
 - b. Finish: Powder Coat.
 - 1) Color: Black.
 - c. Basis of Design:
 - 1) Rakks as manufactured by Rangine Corporation.
 - 3. Pre-Fabricated Countertop Support:
 - a. Basis of Design Products:
 - 1) Aluminum Standard Brackets manufactured by A&M Hardware, Inc.
 - 2) Standard Brackets manufactured by A&M Hardware, Inc.
 - 3) Front Mounting Plus manufactured by Centerline Brackets.
 - b. Material:
 - 1) Aluminum
 - 2) 3/8 by 2-1/2 inches (19 by 64 mm) steel.
 - c. Bracket Depth and Height: As recommended by manufacturer.
 - d. Finish: Color Anodized.
 - 1) Color: As selected by the Architect from manufacturer's full range.
 - e. Finish: Powder Coat.
 - 1) Color: Black.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.
- B. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
 - 2. Provide sustainably harvested wood, certified or labeled; refer to Section 01 60 00 - Product Requirements.
 - 3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
 - 4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- C. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- E. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- F. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- G. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
 - 1. Color: As indicated on drawings.
 - 2. Color: As selected by the Architect from manufacturer's full line.

- H. Joint Sealant: Mildew-resistant silicone sealant, white.

2.5 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash where indicated on Drawings.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.
- D. Stainless Steel: Fabricate tops up to 144 inches (3,657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
1. Weld joints; grind smooth and polish to match.
 2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
 3. Provide wall clips for support of back/end splash turndowns.
 4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.
 5. Integral sinks: Fabricate with corners rounded and coved, double-walls for sink compartment partitions, and drainboards. Factory-punch holes for fittings, and weld sinks to countertops.
- E. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings

- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Seal joint between back/end splashes and vertical surfaces.
 - 1. Where indicated use rubber cove molding.
 - 2. Where applied cove molding is not indicated use specified sealant.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 36 00

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SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufacturer-engineered, shop-fabricated structural steel building frame.
 - 2. Insulated Metal wall and roof panels including soffits, gutters and downspouts, and roof mounted equipment curbs.
 - 3. Exterior windows.
 - 4. Skylights.
 - 5. Exterior overhead doors and frames.
 - 6. Ventilators.
 - 7. Louvers.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 07 92 00 - Joint Sealants: Sealing joints between accessory components and wall system.
 - 3. Section 08 11 13 - Hollow Metal Doors and Frames.
 - 4. Section 08 13 16 - Aluminum Doors.
 - 5. Section 08 33 23 - Overhead Coiling Doors.
 - 6. Section 08 36 13 - Sectional Doors.
 - 7. Section 08 51 13 - Aluminum Windows.
 - 8. Section 08 62 00 - Unit Skylights.
 - 9. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.
- I. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

- K. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
- M. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- N. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2023.
- O. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- P. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2025a.
- Q. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- S. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- T. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- Y. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2024.
- Z. MBMA (MBSM) - Metal Building Systems Manual; 2024.
- AA. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- BB. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on profiles, component dimensions, fasteners.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
- D. Samples: Submit two samples of precoated metal panels for each color selected, ____by____ inch (____by____ mm) in size illustrating color and texture of finish.
- E. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement.

- F. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
 - 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
- I. Exterior Product Approvals:
 - 1. Manufacturer shall certify that product complies with and has been tested and approved in compliance with Florida Product Approval or Miami Dade NOA and applicable requirements.
 - 2. Exterior Product Approvals: Manufacturer shall certify that product complies with large [and small] missile impact criteria and has been tested and approved in compliance with Florida Product Approval or Miami Dade NOA and applicable requirements.
- J. Erector's Qualification Statement.
- K. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- L. Project Record Documents: Record actual locations of concealed components and utilities.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
 - 1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
 - 2. Comply with applicable code for submission of design calculations as required for acquiring permits.
 - 3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 360 and MBMA (MBSM).
 - 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
 - 2. Accredited by IAS in accordance with IAS AC472.
- D. Erector Qualifications: Company specializing in performing the work of this section approved by manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for _____.
 - 1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 ASSEMBLIES

- A. Frames: As indicated on Drawings.
- B. Bay Spacing: As indicated on Drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, and wind bracing.
- D. Secondary Framing: Purlins, and other items detailed.
- E. Wall System: Preformed metal panels of horizontal profile, with sub-girt framing/anchorage assembly, and accessory components.
- F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, and liner panels, and accessory components.
- G. Roof Slope: 1/8 inches in 12 inches (1/100).

2.3 PERFORMANCE REQUIREMENTS

- A. Installed Thermal Resistance of Wall System: R-value of ____ (RSI-value of ____).
- B. Installed Thermal Resistance of Roof System: R-value of ____ (RSI-value of ____).
- C. Design structural members to withstand dead load, and design loads due to pressure and suction of wind calculated in accordance with applicable code.
- D. Design structural members to withstand ____ psf (____ kPa) live load, ____ psf nominal snow load, (____ kPa nominal snow load,) and ____ psf (____ kPa) positive and negative wind loads.
- E. Design structural members to withstand Class 30 wind uplift in accordance with UL 580.
- F. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/90 of span.
- G. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- H. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of ____ degrees F (____ degrees C).
- I. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.4 MATERIALS - FRAMING

- A. Structural Steel Members: ASTM A36/A36M.
- B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
- C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
- D. Anchor Bolts: ASTM A307, Grade A, with no preference for protective coatings.
- E. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with no preference for protective coating.
- F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
- G. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.

- H. Primer: SSPC-Paint 20 zinc rich.
- I. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
 - 3. Height Change, Plastic State: When tested in accordance with ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.

2.5 MATERIALS - WALLS AND ROOF

2.6 COMPONENTS

- A. Doors and Frames: Manufacturer's standard.
- B. Aluminum Doors: Refer to Section 08 13 16 - Aluminum Doors.
- C. Hollow Metal Door: Refer to Section 08 11 13 - Hollow Metal Doors and Frames.
- D. Overhead Doors and Frames: Manufacturer's standard.
 - 1. Glass and Glazing: Refer to Section 08 80 00 - Glazing.
- E. Overhead Coiling Doors: Refer to Section 08 33 23 - Overhead Coiling Doors.
- F. Sectional Doors: Refer to Section 08 36 13 - Sectional Doors.
- G. Overhead Door Frame: Formed steel sections braced to building frame specified in Section 05 50 00 - Metal Fabrications.
- H. Windows: Manufacturer's standard.
 - 1. Glass and Glazing: Refer to Section 08 80 00 - Glazing.
- I. Aluminum Windows: Refer to 08 51 13 - Aluminum Windows.
- J. Unit Skylight: Manufacturer's standard.
 - 1. Single Dome: Acrylic plastic, ____ inch (____ mm) thick; clear.
 - 2. Double Dome: Acrylic plastic, ____ inch (____ mm) thick; air seal the space:
 - a. Outer Dome: Clear.
 - b. Inner Dome: Clear.
 - 3. Nominal Size: ____ inch by ____ inch (____ by ____ mm) per unit.
 - 4. Configuration: _____ units.
 - 5. Shape: _____.
 - 6. Unit Frame: Extruded aluminum thermally broken, integral curb frame and counterflashing, with integral condensation drainage gutter.
 - 7. Support Curb: Aluminum sandwich construction; ____ inch (____ mm) thick, ____ inch (____ mm) high, fibrous glass insulated, with flange for anchorage to roof deck, counterflashed and formed to roofing metal.
- K. Unit Skylight: Refer to Section 08 62 00 - Unit Skylight.
- L. Ventilators: Sheet steel, galvanized, rotary design, ____ inch nominal size (Sheet steel, galvanized, rotary design, ____ mm nominal size).
- M. Wall Louvers: _____ type Z blade design, same finish as adjacent material, with steel mesh bird screen and frame, blank sheet metal at unused portions.

2.7 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- C. Provide framing for skylight openings.

- D. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

- A. Siding: Minimum ____ inch (____ mm) metal thickness, ____ profile indicated, ____ inch (____ mm) deep, lapped edges fitted with continuous gaskets.
- B. Siding: Refer to Section 07 42 13 - Metal Wall Panels.
- C. Roofing: Minimum ____ inch (____ mm) metal thickness, ____ profile, lapped edges fitted with continuous gaskets.
- D. Roofing: Refer to Section 07 42 13 - Metal Wall Panels.
- E. Roofing: Refer to Section ____.
- F. Liner: Minimum ____ inch (____ mm) metal thickness, flat profile indicated, lapped V edges fitted with continuous gaskets.
- G. Soffit Panels: Minimum ____ inch (____ mm) metal thickness, flat profile indicated, perforated for ventilation.
- H. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- I. Internal and External Corners: Same material thickness and finish as adjacent material, profile shop-formed to required angles. Back brace mitered internal corners with ____ inch (____ mm) thick sheet.
- J. Expansion Joints: Same material and finish as adjacent material where exposed, ____ inch (____ mm) thick, manufacturer's standard shop-formed sheet metal type, of profile to suit system.
- K. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
- L. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts and scuppers of _____ profile and size indicated to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

- A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.
- B. Exterior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish, _____ color as selected from manufacturer's standard range.
- C. Interior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish, _____ color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.

- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches (50 mm). Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners.
- G. Install insulation and vapor retarder utilizing _____ for attachment. Place wire mesh under vapor retarder for support between framing members.
- H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Apply bituminous paint on surfaces in contact with cementitious materials.
- C. Slope gutters minimum ____ inch/ft (____ mm/m).
- D. Connect downspouts to storm sewer system.
- E. Install splash pans under each downspout.

3.5 ERECTION - SKYLIGHTS

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate with installation of roofing system and related flashings.
- C. Apply bituminous paint on aluminum surfaces of units in contact with dissimilar metals.
- D. Seal between skylight units and roof system, providing weather tight installation.

3.6 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, overhead doors, and windows and glass in accordance with manufacturer's instructions.

3.7 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
- B. Siding and Roofing: 1/8 inch (3 mm) from true position.

END OF SECTION 13 34 19

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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- C. SECTION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- F. SECTION 21 13 39 - FOAM-WATER SYSTEMS
- G. SECTION 21 22 00 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS.
- H. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT
- I. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between

the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- C. All materials and distribution, and utilization equipment shall be UL Listed.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

- A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.
- B. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
 - 3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 20 - Installation of Centrifugal Fire Pumps
 - e. NFPA 24 - Installation of Private Fire Service Mains
 - f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
 - g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems

- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.
- E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Access Panels
 - 2. Floor, Wall, and Ceiling Plates
 - 3. Insulation
 - 4. Heatrace
 - 5. Piping and Equipment Identification
 - 6. Painting

1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical,

plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

- A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.
- B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.
- C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in

accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.11 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
 - 1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 - 2. Samples, where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution
- F. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.13 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 - 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
 - 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents,

prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.

2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.

12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.16 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.17 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building

modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.19 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.20 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 3. Facilities with over 1000 sprinklers – 24 minimum

1.21 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
1. Number of Copies: Submit one set of marked up record prints.
 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents

2. Remove Engineer's seal, name, address and logo from drawings.
3. Mark documents AS-BUILT DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY.
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground plumbing and flow line elevations.
7. Indicate exact location of all underground mechanical piping and elevations.
8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.22 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:
1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
 2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
 3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
 4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
 5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

- A. The following shall be insulated:
 - 1. All fire suppression water piping above grade (outdoor).
 - 2. All fire suppression water piping above grade (un-condition space).
 - 3. Acceptable manufacturers:
 - a. Manville Corporation.
 - b. Certain-Teed.
 - c. Owens Corning Fiberglass.
 - d. Knauf Insulation.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
 2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
 - a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
 2. Foil and Paper Jacket: Not acceptable.
 3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. PVC Jacket Color: White.
 - c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
 - d. Not to be used for outdoors.
 4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
 - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or

- less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Not to be used for outdoors.
 - 5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 - a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
 - b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
 - c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
 - 6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Accessories and Attachments
- 1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.
- I. Vapor Retardants
- 1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.

- H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.
- J. All piping shall be insulated with 1" thick fiberglass insulation.
- K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.7 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:
 - 1. All above ground fire protection standpipe and sprinkler piping
 - 2. All above ground sprinkler drainage piping
- B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
 - 1. Sprinkler piping
 - 2. Dry Sprinkler piping
 - 3. Drain piping
 - 4. Pre-Action piping
 - 5. Clean Agent piping
 - 6. FDC piping
- C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- G. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified

above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.

- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
 - 1. Permanently attached plastic laminate signs with 1" high lettering.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.9 PAINTING

- A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.
- B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect
- C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Provide a pressure gauge at the top level of all standpipes.
- J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- O. Building shall be 100 percent fully sprinklered.
- P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

- R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- S. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- T. Provide protection in all gymnasium areas.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.
- L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

- A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.
- B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.
- C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.

- D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.
- E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.
- F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.
- G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.
- H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

- A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.
- B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

- A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.
- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

- A. Installation and workmanship requirements are specified hereinafter.

- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated

- system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
 - I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
 - J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
 - K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operation and Maintenance Manual":

3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).

3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 4. Provide complete information for products specified in Division 23.
 5. Provide certificates of compliance as specified in each related section.
 6. Provide start up reports as specified in each related section.

7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide all work for plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.
- B. All materials and equipment for the potable water system shall meet the latest amendments, mandates, and requirements for lead free required by law that went into effect January 2014.
- C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc., required and/or necessary to completely install, clean, inspect, adjust, test, balance, and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- D. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the building(s) and plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include all temporary services required to keep the Owner-occupied portions of the building(s) operational without interruption of plumbing and fire protection services for the duration of the project.
 - 3. Refer to architectural Drawings for description of phasing, stage all plumbing work and fire protection work accordingly.
- E. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.
- F. Unless directly specified otherwise, all noted pipe diameters herein are nominal.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, Specifications, local ordinances, industry standards, utility company regulations, and nationally accepted codes.
- B. All materials, distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused, of United States domestic manufacture, and comply with the Buy America Act, unless approved otherwise by the Engineer or Owner.

- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer to not be an inherent part of the systems as designed without additional cost to the Owner.
- E. An approved Contractor for the work under this Division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than (3) systems of comparable size and type that have served their Owners satisfactorily for not less than (3) years.

1.4 WORK INCLUDED

- A. Systems: Plumbing systems installed, and the work performed under this Division of the Specifications, shall include, but are not necessarily limited to, the following systems as noted below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically noted otherwise.
 - 1. Compressed air system
 - 2. Domestic cold water, hot water, hot water recirculation systems
 - 3. Domestic water softening system
 - 4. Natural gas systems
 - 5. Sanitary drainage, waste, vent systems
- B. Contract quality control including workmanship, manufacturer's instructions, mock-ups, and demonstrations.
 - 1. Executing Mock-ups:
 - a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals, and finishes.
 - b. Do not proceed with any work involving a mock-up until the related mock-up has been approved in writing.
 - c. Acceptable mock-ups in place shall be retained in the completed work.
 - d. Perform tests and submit results as specified.
 - 2. Scheduling Mock-ups: Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer for:
 - a. Rough-in
 - b. Finish with all appurtenances in place
 - c. Insulation installed
 - d. Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably

implied as essential, whether mentioned in the Contract Drawings and Specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.

- B. Provide all rigging required for complete installation and furnish Drawings showing necessary points of support, reactions, and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.
- C. Become thoroughly acquainted with the work involved; obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this Division necessary for the proper installation of their Contracts. Confer with other Contractors for finish adjacent to work of this Section and arrange to have visible portions of the work (e.g., access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architect.
- D. Transmit to trades doing work of other Sections all information required for work to be provided under their respective Sections (e.g., freshwater connections, foundations, electric wiring, access doors, etc.) in ample time for installation.
- E. Where disagreements occur between the Plans and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this Division with all other Divisions to ensure that all components of plumbing and fire protection systems will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the plumbing and fire protection systems' components.
- C. Make all plumbing and fire protection connections to all equipment furnished by this Division and as required by any other Division.
- D. Electrical wiring, control equipment, and motor starters indicated on the electrical Drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the plumbing trades, either in these Specifications or on the plumbing Drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical Drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these Specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with plumbing equipment shall have overload protection in all phases. It shall be the responsibility of each Subcontractor furnishing motors and devices to advise electrical Contractor of exact function of systems to assure proper type of starter with correct number of auxiliary contacts for proper operation of the system.
- F. The plumbing trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner because of lack of such coordination.

- G. The design of the electrical system(s) is based on the plumbing equipment specified and scheduled on the Drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the plumbing trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems shall be furnished and installed under Division 26. Coordinate locations with electrical Contractor.

1.7 DRAWINGS

- A. The Drawings are schematic in nature but shows the various components of the system(s) approximately to scale and attempts to indicate how they are to be integrated with other parts of the building. Contractor shall determine exact locations by review of equipment manufacturer's data, jobsite measurements, checking the requirements of other trades, and reviewing all Contract Documents. The size of the plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed and approved manufacturers shall be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The Drawings are not intended to show exact locations of pipes and ducts, nor to indicate all offsets, fittings, and supports, but rather to indicate approximate layout.
- B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in nature and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances, structural conditions, and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases, suspended ceilings, soffits, finished portions of the building, etc., unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing, and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system(s) involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement, and extent of equipment, devices, and other appurtenances related to the installation of the work shown on the Drawings are approximate. The Contractor shall not scale Drawings; rather, the Contractor shall refer to the Architect Drawings for exact dimensions of building components. Should a conflict exist between the Architect and Engineer Drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

- E. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. The Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in these Specifications and the procedures covered by these Specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. Refer to Division 01 Specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cutsheets, performance and test data, and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who, in their judgement, is unsuitable for use on the Project and that decision shall be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request, identify the product, fabrication method, or installation method to be replaced by the substitution; include related Specifications Section(s), Drawing(s), and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate with each request, the following information:
 - 1. Product data, drawings, and descriptions of products, fabrication methods, and installation procedures.
 - 2. Samples where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and construction, to be performed by the Owner and separator Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - 6. Cost information, including a proposal of the net change, if any, in the Contract Sum.

7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including the Architect and Engineer's redesign and evaluation costs, resulting from the use of the proposed substitution.
9. Conditions: The Contractor's request for substitution will be received and considered when extensive revisions to the Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented, properly submitted, and when one (1) or more of the above conditions are satisfied, then the substitution will be judged and determined by the Architect and Engineer; otherwise, the requests will be returned without action except to record non-compliance with these conditions and requirements.

1.9 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each Specifications Section.
- B. Coordination drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the ductwork and piping as well as the major mechanical, plumbing, and fire protection equipment are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at one-eighth (0.125) inch scale or larger and drawing per building area. Provide one-quarter (0.25) inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal shall be included in the Operation and Maintenance (O & M) manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in the comments section of the Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and shall be required to furnish product(s) named in the Specifications and/or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that the required correction(s) noted on the Engineer's Submittal Cover Letter have been received and complied with by the manufacturer(s). If equipment onsite is not in compliance with the correction(s) noted, then the Contractor shall be responsible for the cost of removing and replacing the equipment.

- D. Materials and equipment which are purchased or installed without submittal review and approval will be removed and replaced with specified equipment at the Contractor's expense.
- E. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc., shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to which item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc., of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 - General Requirements and each Specification Section.

1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the plumbing or fire protection system components within the available space as indicated on the Drawings, the Contractor shall prepare a sketch to the minimum one-eighth (0.125) inch scale clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the Contract Documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these Contract Documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Service outages required by the new installation shall only be permitted at a time approved by the Owner. The Contractor shall allow the Owner a two (2) week window to schedule required outages. The time allowed for outages shall not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:

1. During the construction of this project, normal facility activities will continue in existing building(s) until the new building(s) or renovated area(s) are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building(s).

D. Demolition and Work Within Existing Building(s):

1. In the preparation of these documents, every effort has been made to show the approximate locations of - and connections to - the existing piping, duct, equipment, and other apparatus related to this phase of the work; however, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the existing facilities and related areas. Prior to the submission of a proposal, the Contractor shall inspect and verify all details and requirements of all the Contract Documents. All discrepancies between the Contract Documents and actual jobsite conditions shall be resolved by the Contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this contract.
2. All equipment and/or systems noted on the Contract Drawings "TO REMAIN" shall be inspected and tested onsite to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions/costs, shall be made by the Contractor to the Architect/Engineer for review.
3. All equipment and/or systems noted on the Contract Drawings "TO BE REMOVED" shall be removed—including associated system connections. Where duct or pipe is to be capped for future extension or end-of-line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an associated electrical connection, the Electrical Contractor shall disconnect equipment and remove wiring back to the panel or disconnect switch. Contractor shall remove or relocate equipment and the associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing building(s) or be conducted in a manner causing harm or danger to any person(s) on the premises. All fire exits, stairs, or corridors required for proper access, circulation, or exit shall remain clear of equipment, materials, or debris. The General Contractor shall maintain barricades separating the work area(s) from the occupied area(s).
5. Certain work during the demolition and construction phases of the construction process may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation(s) with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment, as determined by the Owner, shall be delivered to the Owner and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

7. Equipment, piping, or other potential hazards to the occupants of the building shall not be left overnight nor outside of the designated working or construction area(s).
8. The Contractor shall make every effort to minimize damage to the existing building(s) and the Owner's property. Repair, patch, or replace as required any damage which might occur because of work at the jobsite. Care shall be taken to minimize interference with the Owner's activities during construction and to keep the construction-disrupted area(s) to a minimum.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of existing equipment and plumbing fixtures as required by the field conditions to allow the installation of the new system(s) regardless of whether such rerouting, reconnecting, or relocating is explicitly shown on the Contract Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation, and plumbing services for the existing area(s).
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls, and appurtenances not included in the remodel or alteration area(s) shall remain in place.
11. Pipe, duct, equipment, and controls that are disconnected to perform remodeling work shall be reconnected in such a manner as to leave system(s) in proper operating condition.
12. No portion of the fire protection system(s) shall be turned off, modified, or changed in any way without the express knowledge and written permission of the Owner's representative(s) to protect the system(s) that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with minimized disruption or downtime.
14. Refer to architectural demolition and/or alteration Drawings for actual location(s) of walls, ceilings, etc., being removed and/or altered.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials onsite in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original packaging.
- C. Do not deliver items to jobsite before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.14 GENERAL ELECTRIC REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices, and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. The Contractor shall notify the Architect/Engineer fourteen (14) days in advance in writing before bids are due if it is necessary to adjust the horsepower of any motors or modify any

electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.15 ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

- A. Plumbing equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277 volt, 120 volt, 24 volt, etc.).
- C. During the submittal process, any proposed deviations from the specified equipment in the Contract Documents shall be clearly indicated on the Plumbing submittal(s). Voltages shall match that of the specified equipment in the Contract Documents; however, if the submitted equipment ampacity, horsepower, etc., differs from the specified equipment, then the Contractor shall coordinate any changes required for the submitted equipment's electrical characteristics with the Electrical Contractor at no additional cost to the Owner.
- D. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having the starting and running characteristics consistent with the torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of the driven equipment on the Shop Drawings.
 - 3. Contractor shall verify electrical characteristics of each motor with the Electrical Drawings.
 - 4. Motors which are shipped loose from equipment shall be set by the supplying Subcontractor.
 - 5. Alignment of motors factory-coupled to equipment and motors field-coupled to equipment shall be rechecked by the millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and rechecked again after forty-eight (48) hours of operation in designed service.
 - 6. Where possible, motors shall be factory mounted.

1.16 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. The original set of as-built drawings shall be scanned and transmitted to the Architect/Engineer in both full size bond (print) and Portable Document Format (PDF).

- C. As-Built drawings: Two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each of PDF and AutoCAD 2015 files on a compact disc (CD).
1. Number of Copies: Submit one (1) set of marked-up as-built prints.
 2. Number of Copies: Submit copies of as-built drawings.
 - a. Initial Submittal:
 - 1) Submit PDF of scanned as-built prints and one (1) set of the prints itself.
 - 2) Submit as-built AutoCAD digital files and one (1) set of the files plotted in PDF.
 - 3) Architect will indicate whether general scope of changes, additional information record, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF of scanned as-built prints and three (3) sets of prints itself.
 - 2) Submit as-built AutoCAD digital files and three (3) sets of the files plotted in PDF.
 - 3) Plot each drawing file whether changes and additional information were recorded.
- D. As-built drawings should indicate the following information at a minimum:
1. Indicate all addendum changes to the Contract Documents.
 2. Remove Engineer's seal, name, address, and logo from the drawings.
 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 5. Indicate all changes to construction during the construction process.
 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
 8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
 9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.

10. Location and size of all plumbing piping above ceiling—including exact locations of valves.
11. Indicate exact locations of all fire protection sprinkler heads and zone valves in the system.
12. Indicate exact locations of all roof-mounted equipment, wall, roof, and floor penetrations.
13. Indicate all changes with clouding around said changes.

1.17 STARTUP SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and startup of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report shall be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the Owner's personnel shall be provided following certification of the assembly.

1.18 COORDINATION OF TRADES

- A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Piping, fixtures, and plumbing equipment shall not be installed without first coordinating the installation of it with other trades. The Contractor, at their own expense, shall relocate all piping, fixtures, and plumbing equipment installed without coordination should the plumbing elements interfere with the proper installation and mounting of electrical elements, mechanical elements, technology elements, ceilings, architectural elements, and structural elements.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other trades and disciplines prior to installation.
- D. In areas where more than one trade is required to utilize common openings in structural beams, joists, chases, shafts, and sleeves for the passage of conduits, raceways, piping, ductwork, and other materials, the Contractor shall coordinate the positions of all piping and plumbing equipment to be furnished under this Division so that all items, including the materials and equipment of other trades and disciplines, may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this Division does not interfere with the clearances required for finished columns, pilasters, partitions, walls, or other architectural and structural elements as shown on the Contract Documents.
- F. Work that is installed under this contract and interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract Documents.
- G. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and architectural finish conditions affecting all their work and shall arrange such work accordingly for the complete and satisfactory operation of all systems. The Contractor shall provide all offsets, fittings, valves, devices, and accessories that may be required to meet such conditions.

1.19 WARRANTY

- A. All equipment furnished and installed under this Division shall be provided with the manufacturer's standard warranty unless otherwise noted.
- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. To "make good all defects" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.
- B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories.
- D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron waste piping and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Acceptable manufacturers:
 - 1. Precision Plumbing Products
 - 2. MIFAB
 - 3. Acudor
 - 4. Elmdor
 - 5. Milcor
- B. Group valves together above suspending ceilings, walls, furred spaces, etc. to minimize the number of access panels required, but with all valves freely accessible for easy maintenance and inspection. Locate all valves within 1'-0" of the access panel entry point. Minimum size requirements shall be:
 - 1. 18" X 18" for electrical-related items
 - 2. 24" X 24" for plumbing-related items
 - 3. 36" X 36" for mechanical-related items
- C. Furnish access panels of proper size to service concealed valves, cleanouts, etc. as required. Panels shall be of the proper type for the material in which they occur and are to

be furnished by the Contractor but installed by the trade for the material in which the access panel is installed.

- D. Panels shall have flush doors with sixteen (16) gauge steel door; sixteen (16) gauge frame; metal wings for keying into construction; concealed hinges; screwdriver-operated stainless steel cam lock; shop-coated with one (1) coat of zinc chromate primer.
- E. Access panels shall not be installed in gypsum ceilings in public spaces.
- F. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.3 INSULATION

- A. The following system(s) shall be insulated:
 - 1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
 - 2. All domestic hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
 - 3. All horizontal storm drainage (primary) and overflow drainage (secondary) piping as well as roof drain bodies.
 - 4. All domestic water piping exposed to areas subject to freezing. Refer to Section 22 05 00, Subsection 2.4 "HEAT CABLE FOR FREEZE PROTECTION OF PIPING" for additional requirements and information.
 - 5. HW & HWR piping should be in fiberglass, DCW, Storm drain and condensate should be in cellular foam (Armaflex), or Phenolic foam
- B. Domestic water, storm drainage, and waste drainage piping shall be insulated with four (4) lbs. density sectional fiberglass insulation. Insulation thermal conductivity k-value shall not exceed 0.24 and insulation shall have white "all service jacket" with vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with "all service jacket" three (3) inch wide tape. Insulation shall be used for exposed piping.
- C. Acceptable manufacturers:
 - 1. Johns Manville "Micro-Lok AP-T"
 - 2. Knauf "ASJ/SSL"
 - 3. Owens Corning "ASJ/SSL"
- D. Minimum requirements for piping system insulation and insulation thickness shall be as shown in the table below:

MINIMUM PIPE INSULATION			PIPE SIZE INSULATION THICKNESS (Ø)				
SYSTEM	FLUID TEMP RANGE		≤ 1"	1-1/4" - 2"	2-1/2" - 4"	5" and 6"	≥ 8"
	°C	°F	inch	inch	inch	inch	inch
Domestic cold water	ambient	ambient	0.5	1.0	1.0	1.0	-
Domestic hot water and hot water return	43.0 - 71.0	110.0 - 160.0	1.0	1.5	1.5	1.5	-

Sanitary waste above grade receiving condensate or ice machine discharge	4.5 - 15.5	40.0 - 60.0	0.5	1.0	1.0	1.5	-
Primary and secondary storm drainage	ambient	ambient	-	-	1.0	1.0	1.0

- E. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping with fiberglass insulation and with "all service jacket" protection. For exposed locations, provide one (1) inch thick rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow fitting and including all wye fittings, all the way to the change in direction at the vertical drop to below grade.
- F. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping, including the roof drain bodies, with blanket-type glass fiber bonded thermosetting resin, white vinyl vapor retarding surface, and two (2) inch wide stapling/taping tab. Insulation shall be used in concealed spaces.
- G. Insulate all horizontal sanitary waste piping receiving air-conditioning condensate or ice machine discharge with minimum one (1) to one and one-half (1.5) inch fiberglass insulation with jacket. Begin from the floor drain, including the p-trap, and insulate all the way to the change in direction at the vertical drop to below grade.
- H. At natatoriums, including the pool equipment rooms, insulate all exposed plumbing piping with a complete aluminum jacketing system. Provide color-coded, printed pipe identification label ten (10) feet on center indicating pipe system type (e.g., storm drainage, domestic water, gas, etc.).
- I. Aluminum jacketing:
 - 1. Jacket for piping shall be 0.016 inches thick, type 3105 aluminum with factory-applied one (1) mil polykraft moisture barrier.
 - 2. Covers for fittings shall be 0.024 inches thick, type 1100 aluminum to match pipe covering.
 - 3. Aluminum jacketing shall be provided for all exposed piping.
 - 4. Acceptable manufacturers:
 - a. ITW Insulation Systems Pabco/Childers
 - b. RPR Products

2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat cabling on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Acceptable manufacturers:
 - 1. Raychem
 - 2. Chromalox
 - 3. BriskHeat
 - 4. Thermon

- C. Provide Raychem XL-Trace or an approved, accepted manufacturer. Heat cable shall operate at five (5) watts per foot, 120VAC, and without the use of transformers. Provide the quantity of 120VAC branch circuits required to serve the entirety of the heat cable load at a maximum of 1800 watts per circuit.
- D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power connections, end seals, and controllers to ensure proper freeze protection. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.
- E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.
- F. Provide a complete system of self-regulating heat cable on all domestic water piping in crawl spaces, un-conditioned attic spaces, outdoors, and any other locations subject to freezing. Heat cable, accessories, and controls to prevent systems from freezing shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).
- G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the protected piping systems are complete. Heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc.
- H. Heat cable shall be capable of maintaining a minimum water temperature of 40°F at an ambient air temperature of 0°F.
- I. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.
- J. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 40°F.
- K. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.
- L. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.
- M. Provide a minimum of one (1) inch thick fiberglass insulation on all piping with heat cabling.

2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING

- A. Provide electric heat cabling on all domestic hot water piping to maintain the temperature of the fluid in the piping downstream of the domestic hot water loop. Provide up to within twenty-four (24) inches of the fixtures being served to meet all the mandates of the energy efficiency codes per the City of New Braunfels.
- B. Acceptable manufacturers:

1. Raychem
 2. Chromalox
 3. BriskHeat
 4. Thermon
- C. Provide Raychem HWAT-R2 with Raychem HWAT-ECO-GF controller or an equal, accepted manufacturer. Heat cable shall operate at 208VAC or 277VAC and without the use of transformers. Provide the quantity of 208VAC and 277VAC branch circuits required to serve the entirety of the heat cable load.
- D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power connections, end seals, and controllers to ensure proper water temperature maintenance. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.
- E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.
- F. Provide a complete system of self-regulating heat cable on all domestic hot water piping that is non-circulated. Heat cable, accessories, and controls to maintain water temperature shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).
- G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the domestic hot water system is complete. Heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the four (4) or eight (8) o'clock position on linear runs. Affix the cable to the pipe every two (2) feet with Raychem AT-180 tape or an equal, accepted manufacturer. Heat cable shall not be compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc.
- H. Penetrations through fire-rated assemblies shall have its own sleeve with fire resistant material equal to STI Firestop.
- I. Heat cable shall be capable of maintaining a minimum water temperature of 105°F and a maximum temperature of 140°F at an ambient air temperature of 50°F.
- J. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.
- K. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 100°F.
- L. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.

- M. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.
- N. Provide a minimum of one (1) inch thick fiberglass insulation for piping with heat cabling up to one (1) inch in diameter. For larger pipe sizes, refer to the manufacturer requirements and guidelines.

2.6 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. Roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic spaces as required to penetrate roofs on the least-visible side(s) of the building.

2.7 FLOOR, WALL, AND CEILING PLATES

- A. Furnish and install heavy gauge, chromium-plated, steel wall and ceiling plates on all exposed pipes in finished areas where piping passes through walls, ceilings, etc.
- B. Plates shall be of the type that will remain permanently in position and, where pipes are insulated, they shall be of the size necessary to cover insulated piping.

2.8 DRAIN PAN

- A. Acceptable manufacturers:
 - 1. DiversiTech
 - 2. Killarney Metals
 - 3. Riverside Sheet Metal
- B. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan under all above grade plumbing piping in the electrical rooms, MDF rooms, and IDF rooms.
- C. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan for water heaters.
- D. Drain pan shall have at least two (2) inches in depth and shall extend at least six (6) inches beyond the plumbing pipe or equipment.
- E. Drain pan shall be installed at least six (6) feet above electrical panels and electrical gear for accessibility and maintenance clearances and shall be installed within six (6) inches below the plumbing pipe or equipment.
- F. Provide steel strut channels and hangers for drain pan support.

2.9 TRACER WIRE

- A. All trace wire and trace wire components shall be domestically manufactured in the United States of America.
- B. All trace wire shall have HDPE insulation intended for direct bury and color-coded per APWA standards for the specific utility being marked.

- C. All trace wire shall be provided for underground, non-metallic system mains four (4) inches and larger.
 - 1. Trace wire shall be installed in the trench on top of the underground, non-metallic piping and then attached to a metal pipe above slab at the end of the run. The wire under Division 22 scope shall extend a maximum of five (5) feet outside the building exterior to an access point.
 - a. Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.
- D. Acceptable manufacturers:
 - 1. Copperhead Industries
- E. Trace wire (copper-clad steel):
 - 1. Open trench installation: direct burial 12AWG, solid steel core, soft drawn tracer wire with 250 lbs. average tensile break load, thirty (30) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and information. Provide Copperhead Industries "1230-SF" or an equal, accepted manufacturer.
 - 2. Directional bore or jacketed installation: direct burial 12AWG, solid steel core, hard drawn, extra high strength, horizontal directional drill tracer wire with 1,150 lbs. average tensile break load, forty-five (45) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and information. Provide Copperhead Industries "1245-HS" or an equal, accepted manufacturer.
- F. Connectors (copper-clad steel):
 - 1. Splices along the continuous run of trace wire for repair of a wire break or replacement of a filed segment of wire shall use 3M "Direct Bury Splice Kits" or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting two or more wires, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
 - 2. Branch connections for laterals, turnouts, services, and appurtenances shall use King Innovation "DryConn" Waterproof Direct-Bury Lug Connectors (Aqua) or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting one or two wires to the main trace wire without cutting the main trace wire, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
 - a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the

resulting tone continues for that part of the associated segment of the underground system.

3. Non-locking, friction fit, twist-on, and taped connectors shall not be acceptable. Twisting of copper wiring shall not be acceptable.

G. Termination and access (copper-clad steel):

1. Termination and access point shall be located a maximum of five (5) feet outside the building exterior. Provide Copperhead Industries "SnakePit" access point or equivalent product by alternative manufacturer that is compatible with the complete tracer wire system.
2. Terminal box shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
3. Terminal box shall consist of tubular housing, terminal board, and removable round lid.
4. Minimum dimensions shall be five and one-half (5.5) inches diameter and eight (8) inches high. Base shall be sized to fit four (4) inch PVC Schedule 40 pipe.
5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of the construction shall be impervious to chemicals typically used for snow and ice removal as well as pavement and hardscape maintenance.
6. Housing and lid shall be designed for easy access and maintenance:
 - a. Turf and landscape areas:
 - 1) Light-duty housing with plastic lid
 - b. Hardscape areas:
 - 1) Heavy-duty housing with cast iron or ductile iron lid
 - c. Roadway, driveway, and parking lot applications shall not be acceptable.
7. Terminal board shall have nickel-plated brass terminals. Terminal quantity for necessary and complete installation of the system shall be provided as required with a minimum of four (4) spare terminals provided.

H. Grounding (copper-clad steel):

1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) feet of 14AWG, red, HDPE insulated, copper-clad steel wire connected to the anode (minimum 0.5 lbs.) that is specifically manufactured for such applications and shall be buried at the same elevation as the utility.
2. Drive-in magnesium anode shall be Copperhead Industries "ANO-1005" (1.5 lbs.) or an equal, accepted manufacturer.

2.10 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied to the piping systems below and as applicable to the scope of work installed under this Division:

1. Acid (vent, waste)
 2. Compressed air
 3. Condensate
 4. Deionized water (supply, return)
 5. Domestic water (cold, hot, hot return)
 6. Gas
 7. Heat trace
 8. Non-potable
 9. Sanitary (vent, waste)
 10. Softened water
 11. Vacuum
- B. Piping identification shall be applied to all piping systems in areas of exposed construction and in areas with accessible ceilings as well as in the following locations:
1. Both sides of each wall, floor, and ceiling penetration
 2. Connections to equipment
 3. Adjacent to valves and flanges
 4. Adjacent to piping obstructed from view
 5. Heat trace pipe runs at no more than ten (10) foot intervals or as required by the local code
 6. Straight pipe runs at no more than twenty-five (25) foot intervals
- C. Adhesive type labels shall not be acceptable, provide only "snap-around" or "snap-on" type labels.
- D. The letter size, background color, and placement of markers shall conform to the requirements of ANSI/ASME A13.1 as well as all OSHA requirements. Identify all interior exposed piping and all piping in chases or plenums with a plastic "snap-around" or "snap-on" label indicating pipe system type and direction of flow arrow. Contractor shall clean piping prior to plastic marker installation. Provide consistent manufacturer for plastic markers of each system such that marker background colors, arrows, and system description are visually identical. Each system shall be clearly identified with a minimum letter size of two and one-quarter (2.25) inches for pipe sizes up to four (4) inches and a minimum letter size of four (4) inches for pipe sizes larger than four (4) inches.
- E. Acceptable manufacturers:
1. Seton Nameplate Corporation
 2. Brady Corporation

- F. Each valve in the Division 21 and Division 22 systems shall be tagged with an individual number stamped onto the valve's tag. Provide identification tags on all emergency fixtures and equipment shut-off valves.
- G. Valve tags shall be brass or plastic laminate, a minimum diameter of one and one-half (1.5) inches, and shall have a brass chain with hook for securing the valve tag to the valve.
- H. Valve tags shall include "P" or "FP" lettering designation to indicate the appropriate plumbing or fire protection system, respectively. Valve tag numbering shall be consecutive for each service of the plumbing or fire protection systems.
- I. Provide a printed, compiled list or schematic drawing for each system indicating the tagged locations as well as a detailed description of the system or equipment being served.
- J. Provide one (1) copy of each list or drawing that shall be framed and mounted at the location designated by the Building Engineer. Provide an additional copy of each list which shall be included in the O & M manual.

2.11 EQUIPMENT LABELING

- A. All equipment shall be labeled; this shall include all pumps, water heaters, storage tanks, compressors, water treatment systems, utility controllers, and other similar equipment.
- B. Equipment labeling shall be completed with the following items, unless noted or specified otherwise:
 - 1. Submit schedule of equipment to be included and their designations.
 - 2. Provide nameplates with one-half (0.5) inch high letters and fastened with epoxy or screws.

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use O & M manuals and actual equipment installed as the basis for instruction.
- C. At conclusion of on-site training program, the Contractor shall have Owner personnel sign written certification that they have completed training and understand equipment operation. Include copy of training certificates in final O & M manual.
- D. No retainage shall be released until the Owner has received all O & M manuals and as-built drawings as well as performed a first O & M walk.
- E. Refer to individual equipment specifications for additional training requirements.

3.2 INSTRUCTION OF OWNER PERSONNEL

- A. Prior to final inspection, the Contractor shall conduct an on-site training program to instruct the Owner's operating personnel of the operation and maintenance for the installed plumbing systems.
 - 1. Provide the training during the Owner's regular working hours.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems with the project.

- B. Time to be allocated for on-site training program:
 - 1. Minimum of eight (8) hours dedicated instructor time
 - 2. Minimum of four (4) hours per day for two (2) days
- C. Before proceeding with the on-site training program, the Contractor shall submit the program syllabus, proposed times and dates, and other pertinent information for review and approval by means of:
 - 1. One (1) copy to the Owner
 - 2. One (1) copy to the Architect
 - 3. One (1) copy to the Engineer
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the O & M manuals as the basis of instruction. Review contents of manual in detail with personnel to explain all aspects of operation and maintenance.
- F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.
- G. Demonstrate equipment functions both individually and as part of the total, integrated system.
- H. Prepare and insert additional data into the O & M manual when the need for additional data becomes apparent during instruction and training.
- I. Submit a report within one (1) week after completion of the on-site training program that demonstrations and instructions have been satisfactorily completed. Provide time, date, and hours devoted to each demonstration and instruction with a list of personnel in attendance.
- J. At the conclusion of the on-site training program, the Contractor shall have an Owner-designated individual sign a certificate to certify that they have a proper and thorough understanding of the demonstrated and instructed systems. By signing the certificate, the individual agrees that all demonstrations and instructions have been satisfactorily completed regarding the scope and content of the O & M manuals used in the on-site training program.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each O & M manual.

3.3 GENERAL REQUIREMENTS

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections required for a complete and satisfactory startup.
- B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed in such a manner and sequence as to avoid damage of components and as required by jobsite progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical, mechanical, technology, and architectural work. Equipment, accessories, and similar items requiring normal servicing or maintenance shall be easily accessible.

- C. The Engineer reserves the right to direct the removal of any item which, in their opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

- A. During construction, all equipment shall be properly protected against damage, defacing, and freezing with manufacturer supplied or recommended shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples, caps, plugs, and test plugs until final connection(s) to the system is made.
- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with protective covers at the following instances:
 - 1. Floor sink opening: Protect and cover with heavy-duty plywood or heavy-duty plastic cover by SmartGuard.
 - 2. Floor drain opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 3. Cleanout opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 4. Pipe opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 5. Fixture opening(s): Protect and cover with plastic sheet cover until final punch list.
- D. Handle and store materials in accordance with the manufacturer and supplier recommendations and in a manner preventing damage to the materials during storage and handling. Replace all damaged materials.
- E. Equipment and materials shall not be installed until the environmental conditions of the jobsite are suitable to satisfactorily protect the equipment and materials. Equipment and materials damaged or subjected to adversarial environmental conditions shall not be acceptable and shall be removed from the jobsite and replaced accordingly.
- F. Use of duct tape or other similar protection methods shall not be acceptable.

3.5 DEMOLITION, REMOVAL, AND EXTENSION OF EXISTING PLUMBING WORK

- A. Disconnect plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. During construction, provide all required connections to maintain operation of existing systems in service at the existing areas of the building(s) to remain.
- C. Maintain access to existing installations to remain active. Modify installation or provide access panels as required to accommodate existing installations remaining active.
- D. When performing work on operating systems, use personnel experienced and trained in similar systems.
- E. Remove, relocate, and extend existing installations to accommodate new construction.

- F. Remove all exposed and abandoned piping systems back to the source of supply, including abandoned systems above accessible ceilings. Cut systems flush with walls and floors, followed by patch and repairing affected surfaces as required.
- G. Extend existing installations to remain using materials and methods compatible with the existing installation, or as specified.
- H. Repair adjacent construction and finishes damaged during demolition and extension work as required.
- I. Normal facility activities shall continue in existing areas to remain in service. MEPT systems servicing existing occupied spaces shall have service maintained and uninterrupted. The Contractor shall schedule any required outages and system service interruptions with the Owner and Architect. Submit a written request indicating service(s) and/or system(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.
- J. For removed equipment and fixtures:
 - 1. Store items at jobsite. The Owner retains rights to all removed items.
 - 2. Allow the Owner ample time to review removed items and to designate which items shall be kept by the Owner.
 - 3. Dispose properly, off-site, all items the Owner chooses to relinquish.

3.6 REMOVAL OF EXISTING PLUMBING MATERIALS (*delete this if project is new construction*)

- A. The Contractor shall modify, remove, and relocate all materials and items as indicated on the Drawings or as required by the installation of new facilities. All material removal and dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination shall be as directed by the Owner. Materials and items scheduled for relocation and that are damaged during dismantling and reassembling shall be repaired and restored to satisfactory and original operating conditions. The Contractor may, at their discretion and upon the approval of the Owner, substitute new materials and items of equal characteristics and quality in lieu of relocating materials and items.
- B. All items which are scheduled for relocation shall be carefully removed in reverse of the original assembly or placement and shall be protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore relocated items to satisfactory and original operating conditions. All relocations shall be performed by workmen skilled in the work being done and in accordance with standard practice of the trade(s) involved.
- C. When items scheduled for relocation are discovered to be in a damaged and irreparable condition before work to dismantle has begun, the Contractor shall bring such items to the attention of the Owner and shall wait to receive further instruction prior to removal. Items damaged during relocation shall be of the Contractor's responsibility and shall be repaired or replaced by the Contractor and as approved by the Owner. Such instances shall be at no additional cost to the Owner.
- D. Service lines to items to be removed, salvaged, or relocated shall be removed to the points indicated on the Drawings, as specified, or as acceptable to the Owner. Service lines not scheduled for reuse shall be removed to the points at which reuse continues or existing service is to remain. Such services shall be sealed, capped, or otherwise tied-off and

disconnected in a safe manner that is acceptable to the Owner. All disconnections or connections from or into the existing facilities shall be done in a manner resulting in minimum interruption of services to adjacent, occupied areas. Services to existing areas and facilities which are to remain in operation during the construction period shall not be interrupted without prior and specific approval of the Owner as herein specified.

- E. Include in the contract price all rerouting of existing piping, fixtures, systems, etc. and all reconnections as necessitated by field conditions to allow the installation of the new item(s). Furnish all temporary piping, fixtures, systems, etc. as required to maintain plumbing services for the existing areas with minimal interruption.
- F. The Contractor shall bear responsibility for loss or damage to the existing facilities to remain and shall bear responsibility for repairing such loss or damage. The Contractor shall send proper notices, make the necessary arrangements, and perform other services required for the care, protection, and operational maintenance of all plumbing services for the new and existing facilities. The Contractor shall erect temporary barricades with the necessary safety devices as required to protect personnel from injury and then removing all such temporary barricades upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall coordinate the removal of doors, piping, fixtures, conduit, wiring, outlet boxes, ductwork, equipment, etc. to provide such access and shall reinstall removed items upon completion of work in the affected areas.
- H. Where partitions, walls, floors, and ceilings of existing construction are scheduled for removal, all Contractors shall coordinate the removal and reinstallation of such items in locations as approved by the Architect. The Contractors involved shall provide all devices required for the operation of the various systems installed in the existing construction.

3.7 EXCAVATION, TRENCHING, AND BACKFILLING

- A. The Contractor shall perform all excavation required to install the work specified herein and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the trench banks to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for the backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavated areas. Any water accumulation therein shall be removed via pumping. All excavation shall be made by open cut. Tunneling and boring shall not be acceptable except underneath pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and supports for piping, fittings, etc. on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth and tamped in twelve (12) inch layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with the specified material for a minimum of twelve (12) inches below invert elevation of the equipment or installation.
- C. The Contractor shall coordinate and provide pipe supports as required per structural Drawings for any void form system such as piping under the slab, piping exiting the building, special requirements on the backfill, etc. and as such all piping shall be supported by an approved, suspended system.
 - 1. System structure:

- a. Provide a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.
 - b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system then remains independent from the securing hangers.
 - c. The open space of the system beneath the structural slab is designed to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.
2. System components:
 - a. The system shall maintain its structural integrity in all humid environment conditions and shall have waterproof components appropriate for its intended performance. All system components, excluding all thread rods, nuts, and washers, shall be furnished by the system manufacturer.
 - b. All vertical all thread rods shall have a component secured toward the top end and permanently affixed into the concrete slab to maintain the specified elevations.
 - c. System shall be installed per the manufacturer's requirements and recommendations. The Contractor shall coordinate the system installation with the structural Drawings and the manufacturer guidelines as required.
- D. The trenches shall be backfilled with cement-stabilized sand materials approved for backfill purposes, deposited in six (6) inch layers, and tamped until the crown of the pipe is covered by a minimum of six (6) inches of material.
 1. Provide a sand-cement mixture producing a minimum unconfined compressive strength of one hundred (100) PSI in forty-eight (48) hours.
 - a. Design shall be based on strength specimens molded in accordance with ASTM D588 at a moisture content within three (3) percent of optimum and within four (4) hours of batching.
 - b. Determine minimum cement content from product data and statistical history. Provide no less than one and one-tenth (1.1) sacks of cement per ton of dry sand.
 2. Cement: Portland cement Type I conforming to ASTM C150
 3. Sand: Clean, durable sand meeting the grading requirements for fine aggregates of ASTM C33 and the following requirements:
 - a. Classified as SW, SP, SW-SM, SP-SM, or SM by the Unified Soil Classification System of ASTM D2487.
 - b. Deleterious materials:

- 1) Organic impurities colored no darker than the standard color and conforming to the requirements ASTM C40.
 - 2) Lightweight pieces less than five (5) percent and conforming to the requirements of ASTM C123.
 - 3) Clay lumps less than one-half (0.5) percent and conforming to the requirements of ASTM C142.
- c. Plasticity index of four (4) or less when tested in accordance with the requirements of ASTM D4318.
- E. Provide a layer of sand at least six (6) inches deep under all plastic pipe installed in soil. Bell end of pipe shall be excavated to ensure that the pipe rests for its entire length upon a solid trench bottom.
- F. The backfill under and beside the pipe shall be compacted for pipe support. The backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirements. The backfill process shall be carried out simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to ninety-five (95) percent of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water shall not be acceptable. Reopen any trenches not meeting compaction requirements or, where settlement occurs, the Contractor shall refill, compact, and restore the surface to the grade and compaction indicated as well as mounded over and smoothed off. A metallic-lined, underground warning tape shall be provided twelve (12) inches below finished grade. The warning tape shall be identifiable as to the type of line per OSHA and ANSI standard nomenclature and color.
- G. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.8 TRACER WIRE EXECUTION

- A. Trace wires shall be installed adjacent to nonmetallic underground water, gas, and main sewage lines underneath the building pad and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping systems as follows:
 1. Natural gas: yellow
 2. Sanitary sewer: green
 3. Storm sewer: green
 4. Water (potable): blue
 5. Water (non-potable): purple
- B. Install trace wire as required by this Section and in accordance with the local codes:
 1. Trace wire shall be installed in the same trench as its associated piping and shall be installed inside bored holes and casing with pipe during pipe installation. Trace wire shall be secured to the pipe as required to ensure that the wire remains

adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved, watertight connector to provide electrical continuity and shall be accessible at all trace wire access points.

2. Prior to backfill, install trace wire on top of pipe and secure in place with ties or hitches at a maximum of ten (10) foot intervals and in accordance with the local jurisdiction's water utility requirements. Run trace wire continuously along the pipe and terminate at access points. Where buried splices occur, use an approved electrical splicing kit only. Provide no less than twenty-four (24) inches of coiled wire at access points for attachment to pipe-locating equipment. Each installed pipe run shall be capable of being located using the trace wire system. Protect wire insulation from damage during installation and backfill. Wire insulation that is broken, cut, or damaged shall be replaced.
3. At the point of connection between existing, conductive pipes, the trace wire shall not be connected to the conductive pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved, waterproof connection to a grounding anode and buried at the same depth as the trace wire. All such connections points shall be grounded.
4. Where existing trace wire is encountered on an existing pipe run that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location(s) as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
5. Trace wire shall be laid flat and securely affixed to the pipe at the three (3) o'clock position. The wire shall be protected from damage during execution of the work. No breaks or cuts in the trace wire or trace wire insulation shall be permitted. At service saddles, placing the trace wire between the saddle and the main shall not be acceptable.
6. At all main end caps, a minimum of six (6) feet of trace wire shall be extended beyond the end of the pipe, coiled, and secured to the cap for future connections. The end of the trace wire shall be spliced to the wire of a six (6) lbs. zinc anode and buried at the same elevation as the pipe main.
7. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valve boxes near pipe intersections, e.g., tees and crosses, may require more than one access point assembly in each concrete valve box collar.
8. At the point of connection between ductile iron water mains and any dissimilar material, the trace wire shall be properly connected to the iron pipe with a "Cadweld" or approved equivalent. Trace wire welds shall be completely sealed with the use of an approved, mastic-type sealer specifically manufactured for installation at below grade. Mastic shall be applied in a thick coat at a minimum of one-quarter (0.25) inch in thickness and shall be protected from contamination by the backfill material with the use of a plastic membrane.
9. Trace wire systems shall be installed as a single continuous wire except where approved connectors are used. Looping or coiling of the wire shall not be acceptable.

10. Any damage occurring during the installation of the trace wire shall be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping or spray coating shall not be acceptable.
11. Open trench installation:
 - a. Trace wire shall be placed a minimum of eight (8) inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems, trace wire shall be laid directly upon pipe and attached at a maximum of ten (10) foot intervals with non-conductive tape. Additional attachment(s) shall be provided at offsets and fittings in the piping system. Trace wire shall be placed carefully, and great care shall be exercised during the backfill process to maintain physical integrity and position relative to piping.
 - b. Splices in trace wire shall be kept to an absolute minimum. When splices are necessary, they shall be made with approved trace wire connectors as specified. Other splicing methods shall not be acceptable.
12. Directional bore or jacketed installation:
 - a. Two (2) trace wires shall be provided with one (1) wire as backup.
 - b. Trace wires shall be pulled through bore hole(s) in conjunction with utility piping. Wires shall be located on opposite sides of utility piping.
 - c. Trace wire splices shall not be acceptable in drilled sections.
13. Trace wires shall be interconnected at intersections of mainlines and branches utilizing a single three-way connector at each point of connection.
14. A terminal box shall be provided at each building utility service entrance and shall be located above piping within five (5) feet of the point of entry into the building.
15. Terminal boxes shall not be located more than one thousand (1,000) linear feet of developed pipe length apart.
16. Terminal boxes shall not be installed at streets, drives, parking lots, or other areas subject to vehicular traffic.
17. Terminal boxes shall not be installed at areas where access to the box is impeded.
18. Terminal boxes shall be installed flush with finished grade and centered in grade-level concrete pads. Concrete pad shall be 18" X 18" minimum and shall be six (6) inches thick.
19. PVC pipe risers shall be firmly attached to the bottom of the terminal box housing and extended downward to an elevation approximately twelve (12) inches above piping. Riser shall serve as a vertical conduit for guiding trace wires into the bottom of the terminal box.
20. Care shall be taken to extend trace wire from utility pipe to the terminal box in an orderly and workmanlike manner as backfill is placed.
21. The end of each trace wire shall be properly landed on a dedicated terminal within the terminal box(es) and securely tightened. Twelve (12) to eighteen (18) inches of excess length shall be provided for each wire within a box. Each terminal shall

be clearly identified with permanent labeling. Where trace wires for multiple utilities are terminated, care shall be taken to ensure accuracy of identification at both ends.

C. Testing:

1. All new trace wire installations shall be located using typical low frequency (512 hertz) line tracing equipment and witnessed by the Contractor, Engineer, and Owner's designated representative prior to acceptance of ownership.
2. The verification shall be performed upon completion of rough grading and again prior to final acceptance of ownership.
3. Final testing of each trace wire shall be performed after the backfill process is complete, terminal boxes have been permanently installed, and wires are terminated. Testing shall be witnessed by the Architect, Engineer, and Owner's designated representative. It may be advisable for the Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing shall not be acceptable.

- D. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.9 CONCRETE WORK

- A. Construct curbs, pads, vaults, and similar supports for equipment where required.
- B. First floor and equipment yard: provide a minimum of six (6) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment.
- C. Second floor and above: provide a minimum of four (4) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment. Dowel pads to the structural slab.
- D. Perform all concrete work in accordance with applicable portions of the concrete sections of the code. Minimum compressive strength of concrete shall be the same as specified for slabs on grade.

3.10 CLEANING OF PIPING SYSTEMS

- A. Provide cleaning of installed piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to completely clean, purge, and circulate the system as required.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, fixtures, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements:
1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line-size blow down ball valve and pipe to nearest drain. Blow down, remove, and clean strainers as frequently as necessary.

2. Phase I: Initial flushing of systems. Remove loose dirt, mill scale, weld beads, rust, and other deleterious substances without damage to the system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until potable water is clear and particles larger than five (5) microns are removed. Connect dead-end supply and return headers, even if not shown on the Drawings, and provide terminal drains in bottom of pipe end caps or blind flanges. Dispose of water in an approved manner.
3. Phase II: Cleaning of piping systems. Remove, without chemical or mechanical damage to any system component, adherent dirt, organic soil, hydrocarbons, soldering flux, mill varnish, piping compounds, rust, and other deleterious substances not removed by initial flushing. Flush system and replace with clean, potable water.
4. Phase III: Final flushing and rinsing of systems. Flush and rinse until potable water is clear and particles larger than five (5) microns are removed. Operate valves to dislodge any debris in the valve body. Dispose of water in an approved manner.
5. Submit status reports upon completion of each phase of work on each system.

3.11 TESTING OF PIPING SYSTEMS

A. General:

1. Prior to insulation and concealment, all piping systems shall be subjected to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's designated representative with a minimum of forty-eight (48) hours' notice given to the parties involved.
3. All equipment, material, labor, and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected fixtures, equipment, accessories, etc. shall be isolated from the piping systems prior to testing.

B. Sanitary piping system: ***(remove if not applicable)***

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section enduring testing. All sections shall be tested with a minimum of ten (10) feet of head. In testing successive sections, at least the upper ten (10) feet of the next section shall be tested so that no piping joint in the building shall undergo a test consisting of less than ten (10) feet of head. The water shall be successfully kept in the system for at least thirty (30) minutes before inspection begins. The system shall then be made tight at all points.
2. Any point(s) of the drainage systems to be tested with air instead of water shall be performed by attaching a compressed air testing apparatus to any suitable opening and, after closing tight all other inlets or outlets, forcing air into the system until

there is a minimum gauge pressure of five (5) PSI. This pressure shall be held without the introduction of additional air for a period of at least thirty (30) minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Interior water piping system:

1. Upon completion of the entire water supply system or a section of it as required, the system shall be tested prior to connection of fixtures, equipment, accessories, etc. and proved tight under a water or air pressure test of at least one hundred and fifty (150) PSI. Pressure shall hold for a period of one (1) hour without introducing additional water or air. Water used for testing shall be from a potable supply source. Defective joints or piping shall be replaced as required and all piping shall be retested as required.

D. Exterior water piping system:

1. All exterior domestic water piping shall be tested to one hundred and fifty (150) PSI for a period of two (2) hours.

E. Compressed air system:

1. All compressed air piping shall be tested to one hundred and fifty (150) PSI for a period of two (2) hours.

F. Vacuum system:

1. All vacuum piping shall be tested to one hundred (100) PSI for a period of two (2) hours.

G. Defective work:

1. If inspection or tests show defects, such defective work or material shall be replaced, and the inspections and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes shall not be acceptable.

H. Additional tests:

1. Provide all additional tests such as smoke, pressure, etc. as required by the regulations or as directed by jurisdictional authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's designated representative to ensure all systems are tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.12 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and performance through the range of its operations. Tests shall be made in the presence of the Architect and Engineer. Provide adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under their respective Specification Sections.

- B. Submit three (3) copies of all certifications and test reports in a timely manner ahead of work completion to allow adequate time for remedial action as required to correct deficiencies discovered in the equipment and plumbing systems.

3.13 DISINFECTION OF INTERIOR AND EXTERIOR WATER SYSTEMS

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authorities having jurisdiction do not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than fifty (50) parts per million of chlorine. The chlorinating solution shall be liquid chlorine of sodium hydrochloride solution and shall be introduced and drawn to all points in the system. The disinfecting solution shall be allowed to remain in the system for a period of eight (8) hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be thoroughly flushed from the system with clear, potable water until the residual chlorine content is no more than two-tenths (0.2) parts per million.
- C. This work shall be supervised or performed by an approved chemical testing laboratory and the results shall be sent to the Engineer or their representative for verification.

3.14 OPERATION AND MAINTENANCE MANUALS

- A. Form of manuals:
 - 1. Prepare data in the form of an instructional manual for use by the Owner's personnel.
 - 2. Format:
 - a. Size: Letter size (8.5" X 11").
 - b. Text: Manufacturer's printed data or neatly typewritten equivalent.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to be of at least the same format size as specified hereinbefore.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover:
 - a. Identify each volume with the printed title, "Operating & Maintenance Instructions" and include the following elements:
 - 1) Title of project
 - 2) Identity of separate structures or facilities as applicable
 - 3) Identity of general subject matter covered in that specific volume
 - 6. Bind as specified.

B. Content of manuals:

1. Provide a neatly typewritten table of contents for each volume, arranged in a systematic order as outlined in the Specifications, and include the following elements:
 - a. The Contractor name, name of responsible principal, address, and telephone number
 - b. Each product required to be included in the table of contents and indexed appropriately to the content of the volume
 - c. Each product's associated address, telephone number, and name of:
 - 1) The Subcontractor or installer
 - 2) Maintenance Contractor, if applicable
 - 3) Identify areas of responsibilities for each party
 - 4) Local source of part supplies and part replacement
 - d. Identify each product by the product name and other identifying symbols as set forth in the Contract Documents.
2. Product data:
 - a. Include sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed
 - 2) Identify data applicable to installation
 - 3) Delete references to inapplicable information
 - a) All options not supplied with equipment shall be marked out or indicated in some manner.
3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Controls and flow diagrams
 - b. Coordinate drawings with information in the Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use the Project Record Documents as maintenance drawings.
4. Written text, as required to supplement product data for a specific installation, shall include:
 - a. Separate headings for different procedures and organized in a consistent format
 - b. Logical sequence of instructions for each procedure

5. Copy each warranty, bond, and service contract issued.
 - a. Provide an information sheet for the Owner's personal indicating:
 - 1) Proper procedures in the event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings, and product data as specified.
- C. Sections for equipment and systems:
1. Content for each unit of equipment and system as applicable:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions
 - 2) Performance curves, engineering data, and tests
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Startup, break-in, routine, and normal operating instructions
 - 2) Regulation, control, stopping, and emergency shutdown instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to troubleshooting
 - 3) Disassembly, repair, and reassembly
 - 4) Alignment, adjusting, and checking
 - 5) Routine service based on operation hours
 - d. Servicing and lubrication schedule as well as a list of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by the controls manufacturer.
 - g. Installed equipment and system control diagrams by the controls manufacturer.
 - h. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include:
 - 1) Predicted life of each part subject to wear
 - 2) Items recommended to be stocked as spare parts

- i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. Color-coded piping diagrams of the installed equipment and systems.
 - l. Charts of valve tag numbers with location and function of each valve.
 - m. Other data as required under relevant sections of the Specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in relevant sections of the Specifications.
 - 4. Provide complete information for products specified in Division 22.
 - 5. Provide certificates of compliance as specified in each related section of the Specifications.
 - 6. Provide startup reports as specified in each related section of the Specifications.
 - 7. Provide signed receipts for spare parts and materials.
 - 8. Provide training report and certificates.
 - 9. Provide backflow preventer certification test reports.
 - 10. Provide gas piping pressure test reports.

END OF SECTION 22 05 00

SECTION 22 05 10 - SANITARY PIPE TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 SUMMARY

- A. Acceptance testing of sanitary sewers including:
 - 1. Visual inspection of sewer pipes
 - 2. Leakage testing of sewer pipes
 - 3. Leakage testing of manholes, sampling wells, interceptors
 - 4. Television and video inspections
- B. All tests listed in this Section are not necessarily required in the project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.3 MEASUREMENT AND PAYMENT

- A. Unit prices:
 - 1. No payment shall be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section "MEASUREMENT AND PAYMENT" for unit price procedures.

1.4 REFERENCES

- A. ASTM C828 "Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines"
- B. ASTM C924 "Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method"
- C. ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill"
- D. ASTM D3034 "Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings"
- E. ASTM F794 "Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter"
- F. ASTM F1417 "Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air"

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test plan:
 - 1. Prior to testing, and in adequate time to obtain approval through the submittal process, prepare and submit test plan for approval by the Project Manager. Include testing procedures, methods, equipment, and a tentative schedule. Obtain advance written approval for deviations from the Drawings and Specifications.
- D. Submit special procedures as required by the manufacturer's installation instructions.
- E. Submit test reports for each test on each segment of sanitary sewer piping.
- F. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 - General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between cleanouts and pipe junctions.
- B. Systems shall meet the Texas Commission on Environmental Quality (TCEQ) testing requirements as defined in Section 217.57 "Testing Requirements for Installation of Gravity Collection System Pipes" and all testing requirements as required by local authorities having jurisdiction.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspections as directed by the Project Manager.

- E. Upon completion of video tape review by the Project Manager, the Contractor will be notified regarding the final acceptance of the sanitary sewer segment.

1.8 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.9 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing such that no more than one thousand (1,000) linear feet of installed sewer remains untested at any given time.
- B. Coordinate testing schedules with the Project Manager. Perform testing under the observation of the Project Manager.

1.10 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXFILTRATION TEST

- A. Backflow preventer: provide a transient backflow preventer for when water used specifically for testing will be taken from the building system. Conform to local code requirements for type of backflow preventer and device application.
- B. Test equipment:
 - 1. Pipe plugs
 - 2. Pipe risers with ten (10) foot head of water (clear marked)

2.2 LOW PRESSURE AIR TEST

- A. Minimum requirements for equipment:
 - 1. Control panel
 - 2. Low pressure air supply connected to the control panel
 - 3. Pneumatic plugs: provide an acceptable size for the diameter of pipe to be tested and the plug shall be capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from the control panel to the:
 - a. Air supply
 - b. Pneumatic plugs
 - c. Sealed line for pressuring
 - d. Sealed line for monitoring internal pressure

- B. Testing pneumatic plugs: place pneumatic plug in each end of pipe length on ground, pressurize plugs to twenty-five (25) PSIG, then pressurize sealed pipe to five (5) PSIG. Plugs are acceptable when they remain in place against test pressure without external aid.

2.3 SMOKE TESTING

- A. Test equipment:
 - 1. Pneumatic plugs
 - 2. Smoke generators as supplied by Superior Signal Company or an approved equal.
 - 3. Blowers producing two thousand and five hundred (2,500) SCFM minimum.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other devices necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps.
- C. If a cleanout or check valve has not been installed at the easement or property line, then the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation within five (5) feet of the foundation wall, then a cleanout shall be provided and installed.
- D. If the building lateral exits the foundation under an existing deck or concrete patio, then the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner and the Engineer.

3.2 VISUAL INSPECTION OF GRAVITY SYSTEM PIPES

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.
- B. Cut ten (10) foot section of pipe and inspect to determine the integrity of the pipe condition.

3.3 LEAKAGE TESTING FOR GRAVITY SYSTEM PIPES

- A. For a gravity system that will transport wastewater by gravity flow, test the gravity system pipes for leakage by either exfiltration or with low pressure air testing.
- B. Compensating for ground water pressure:
 - 1. Where ground water exists, install pipe nipple(s) at the same time the sewer line is placed. Use one-half (0.5) inch capped pipe nipple approximately ten (10) inches long. Make installation through the manhole wall on top of the sewer line where the line enters the manhole.
 - 2. Immediately before performing the line acceptance test, remove the cap, clear the pipe nipple with air pressure, and connect clear plastic tube to the nipple. Support the tube vertically and allow water to rise in the tube. After water stops rising, measure the height in feet of water over invert of pipe. Divide this height by two

and three-tenths (2.3) feet per PSI to determine ground water pressure to be used in line testing.

C. Drainage and vent water test:

1. Determine ground water elevation.
2. Plug sewer in the downstream manhole, cleanout, vent, or pipe stub as necessary.
3. Plug incoming pipes in the upstream manhole, cleanout, vent, or pipe stub as necessary.
4. Install riser pipe in the outgoing pipe of the upstream manhole when the highest point in the service lead (house service) is less than two (2) feet below the bottom of the manhole cone.
5. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, then all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, then each opening shall be tightly plugged, except the highest openings of the section under test, and each section shall be filled with water; additionally, no section shall be tested with less than ten (10) foot head of water. In testing successive sections, at least the upper ten (10) feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost ten (10) feet of the system, shall have been submitted to a test of less than ten (10) foot head of water. This pressure shall be held for not less than fifteen (15) minutes.

D. Drainage and vent air test:

1. Determine ground water elevation.
2. Plug sewer in the downstream manhole, cleanout, vent, or pipe stub as necessary.
3. Plug incoming pipes in the upstream manhole, cleanout, vent, or pipe stub as necessary.
4. Plastic piping shall not be tested using air. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of five (5) PSI or sufficient to balance a ten (10) inch column of mercury. This pressure shall be held for a test period of not less than fifteen (15) minutes. Any adjustments to the test pressure required because of changes in ambient temperatures or the seating of gaskets shall be made prior to the beginning of the test period.

E. Drainage and vent final test:

1. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of the local codes. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one (1) or more smoke machines as required. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a one (1) inch water column shall be held for a test period of not less than fifteen (15) minutes.

3.4 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing, regardless of whether corrections were necessary, and include in the transmittal; two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each (reproducible Dayrex mylar film positives) and AutoCAD 2015 files on a compact disc (CD).
- C. As-built drawings should indicate the following information at a minimum:
 - 1. Indicate all changes to the Contract Documents.
 - 2. Remove Engineer's seal, name, address, and logo from the drawings.
 - 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 - 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 - 5. Indicate all changes to construction during the construction process.
 - 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 - 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
 - 8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
 - 9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
 - 10. Indicate all changes with clouding around said changes.

END OF SECTION 22 05 10

SECTION 22 05 12 - WATER PIPE TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 SUMMARY

- A. Acceptance testing of domestic water including:
 - 1. Visual inspection of building piping systems
 - 2. Cleaning and flushing building piping systems
 - 3. Testing building piping systems
 - 4. Disinfecting building piping systems
 - 5. Placing building piping systems in operation
- B. All tests listed in this Section are not necessarily required in the project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.3 MEASUREMENT AND PAYMENT

- A. Unit prices:
 - 1. No payment shall be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section "MEASUREMENT AND PAYMENT" for unit price procedures.

1.4 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard is the current edition at the time of commencement of the work.
 - 3. Refer to Division 01 - General Requirements for the list of applicable regulatory requirements.
 - 4. Refer to Division 22 - Common Work Results for Plumbing for codes, standards, and other general requirements.
- B. American Water Works Association (AWWA) C651 "Disinfecting Water Mains"
- C. Code of Federal Regulations (CFR) Title 29, Part 1910 "Occupational Safety and Health Standards"

- D. Compressed Gas Association (CGA) G-4.1 "Cleaning of Equipment for Oxygen Service"
- E. Factory Mutual (FM) "Global Property Loss Prevention Data Sheets"
- F. International Association of Plumbing and Mechanical Officials (IAPMO) "Uniform Plumbing Code"
- G. International Code Council (ICC) "International Plumbing Code"

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test plan:
 - 1. Prior to testing, and in adequate time to obtain approval through the submittal process, prepare and submit test plan for approval by the Project Manager. Include testing procedures, methods, equipment, and a tentative schedule. Obtain advance written approval for deviations from the Drawings and Specifications.
- D. Submit special procedures as required by the manufacturer's installation instructions.
- E. Submit test reports for each test on each segment of sanitary sewer piping.
- F. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 - General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Water to be discharged from flushing and disinfecting procedures shall be neutralized and disposed of in accordance with Division 01 or Division 33.

- B. The purpose of these procedures is to ensure that pressure tests are conducted safely and effectively. They cover pressure testing of new and existing pressure systems or components at a test pressure of more than zero (0) PSIG. They apply to mechanics, supervisors, inspectors, custodians, and subcontractors responsible for pressure tests.
- C. Repair, correct, and retest sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspections as directed by the Project Manager.
- E. Upon completion of video tape review by the Project Manager, the Contractor will be notified regarding the final acceptance of the sanitary sewer segment.

1.8 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.9 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing such that no more than one thousand (1,000) linear feet of installed domestic water piping remains untested at any given time.
- B. Coordinate testing schedules with the Project Manager. Perform testing under the observation of the Project Manager.

1.10 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide test equipment at the piping connections between the pipe tested and the water source.
- B. Provide equipment, materials, and facilities required to perform specified tests including, but not limited to, the following:
 - 1. Pumping equipment
 - 2. Calibrated water meter (within six (6) months)
 - 3. Calibrated pressure gauges (within six (6) months)
- C. Sectionalizing devices required including, but not limited to, the following:
 - 1. Flanges
 - 2. Valves
 - 3. Bulkheads

4. Bracing
5. Blocking

PART 3 - EXECUTION

3.1 CLEANING AND FLUSHING

A. Water piping systems:

1. After completion of all work in each section of the various water piping systems and prior to testing, flush all piping to remove foreign materials and to thoroughly clean the system. Flushing shall be continued until the water leaving the system is clear and acceptable to the Owner and Engineer; however, in no case shall the flushing be performed for less than ten (10) minutes.
2. Ensure that adequate quantities of water are available to produce a flushing velocity of not less than two and one-half (2.5) feet per second.

3.2 HYDROSTATIC PRESSURE TEST

A. General:

1. Prior to acceptance and initial operation, inspect and test the piping systems to ensure that the design, materials, fabrication, and installation are in accordance with these specifications.
2. Test piping prior to being enclosed, covered-up, or treated externally with insulation, tape wrapping, mastic coating, and similar treatments.
3. Notify the Owner and Engineer at least forty-eight (48) hours prior to testing and conduct tests in the presence of the Owner's designated representative.
4. Piping systems shall show no pressure loss, unless noted otherwise, while being tested in accordance with this Section of these Specifications. When leakage or other defects are located, repair or replace the affected portion of the piping system and retest. In the event any repairs, replacements, or additions are made to the system following the pressure test, the Contractor shall retest the affected piping. In the case of very minor repairs, replacements, or additions made to the system following the pressure test, the Owner and Engineer at their sole discretion may omit retesting provided that precautionary measures are taken to assure sound construction.

B. General test procedures:

1. All valves shall be in the fully open position during the test. Do not include any components (gauges, relief valves, instrumentation, and similar items) as part of the tests that are not rated for the testing pressure.
2. Remove all persons not directly involved with the test from the immediate test area.
3. Remove pressure relief valves or non-reclosing relief devices from the vessel; or test boundaries where the test pressure will exceed the set pressure of the valve; or hold down each valve by means of an appropriate test clamp and pressurize both sides of the non-reclosing relief devices. Install temporary, higher-rated devices where practical.

4. Install the calibrated test gauge so it is always visible.
5. Pressurize the system by raising the pressure in the system gradually until the designed test pressure is achieved.
6. Do not attempt to modify a piping system when it is pressurized, including tightening leaking joints. Do not repair, replace, or retighten leaking joints or components until the pressure has been reduced to ambient level.
7. Measure test pressure with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate the maximum test pressure. Record any pressure loss due to leakage during the pressure test period while the system is pressurized but isolated from the pressure source.
8. In general, test nonhazardous liquid, inert gas, and compressed air systems at a minimum of one hundred and fifty (150) percent of the working pressure in the line. The test pressure for each piping system shall be not less than the following values, irrespective of the design maximum allowable working pressure (MAWP):

PIPE TESTING REQUIREMENTS			
TEST SYSTEM	TEST PRESSURE	TEST MEDIA	TEST DURATION
	<i>PSIG</i>		<i>hours</i>
Domestic cold and hot water	225	Domestic cold water	24

9. Prepare test records of inspection and all tests performed. Indicate which portions of the piping system are in accordance with these Specifications. Briefly document test procedures, instruments and media used, and test pressures. Before requesting final approval of a piping installation, submit copies of test records for approval by the Owner and Engineer.

3.3 DISINFECTING DOMESTIC WATER PIPING SYSTEM

A. General:

1. Clean and disinfect all cold water systems in accordance with AWWA C651 "Disinfecting Water Mains" when the project is complete and when, by test, the system is proven to be free from leaks and ready for use.

B. Disinfecting procedure:

1. Connect the injection hose to the test connection.
2. With the system completely full of water and the supply valve open, proceed to adjust every valve of the system so that a trickle of water flows from each.
3. Inject the disinfectant slowly, at a uniform rate, until an orthotolidine test at each outlet shows a minimum chlorine residual concentration of one hundred (100) parts per million.
4. Close all outlets and valves, including the valve connecting to the water supply line and the three-quarters (0.75) inch service cock on the solution-injection connection.

5. Maintain the condition for twenty-four (24) hours. If, after the allotted time, the orthotolidine tests indicate that the chlorine residual concentration has decreased below fifty (50) parts per million, then repeat the disinfecting procedure until an approved result is obtained.
 6. When the residual chlorine requirements have been fulfilled, the portion of the water system being disinfected shall be drained and flushed until the chlorine concentration of the discharged water has been reduced to an amount equivalent to the level normally present in the water supplied to the area. This portion of the system shall again be isolated by valving off said portion of the system. All drainage and flushing water shall be directed to the sanitary sewer system.
 7. After checking that the residual chlorine concentration is not greater than control levels using the orthotolidine test, the Contractor shall take water samples after a twenty-four (24) hour incubation period at predetermined locations of the isolated system. The sampling points shall be chosen to provide accurate information regarding the bacteriological quality of the water. Before putting this system into service, the results of these tests must show the water to be completely free (i.e., less than one (1) or none detected) from coliform organisms after the allotted time for the incubation period.
 8. If the results of the bacteriological tests do not meet the standard specified above, the disinfection procedures shall be repeated until this standard is satisfied.
 9. Tie-in fittings to be replaced in existing mains shall be sterilized either by immersing in a chlorine solution of five hundred (500) parts per million for one-half (0.5) of an hour or by swabbing with five (5) percent hypochlorite solution.
 10. On systems where a riser is to be directly connected to an existing underground link that has been previously sterilized and terminates above ground, the double check valves, test cocks, and all piping and fittings between the check valves and the termination of the underground line are to be immersed in a five hundred (500) parts per million chlorine solution for one (1) hour prior to assembly. The termination of the underground line shall not be left uncovered any longer than necessary. The sterilization process shall be monitored by the Owner, Engineer, Inspector, and a designated representative from Berkeley Lab EH&S.
 11. Bennett Marine Utility shall issue a sterilization and chlorination certificate to the Subcontractor to demonstrate satisfactory completion of the above procedure. The Subcontractor shall submit the certificate to Berkeley Lab EH&S for their review.
- C. Disinfecting agent: The Subcontractor shall supply the disinfecting agent; supply the injecting apparatus; inject the disinfecting agent into the system; operate the valves.
- D. Preparation:
1. Provide a test connection for the system to be disinfected within two (2) to three (3) feet of its junction with the water supply lines for injecting the disinfectant into the system.
 2. Prepare the water flow valves for sterilization.
 3. Thoroughly flush the system by fully opening every outlet and operating every fixture until clear water flows from all outlets.

3.4 DISINFECTING LOW CONDUCTIVITY WATER OR DEIONIZED WATER PIPING SYSTEMS

- A. Low conductivity water (LCW) or deionized water (DI): After water system piping is installed and pressure tested, flush system with trisodium phosphate to remove any dirt, oil, and grease as required. After flushing, pump three (3) percent hydrogen peroxide at twenty (20) PSIG to flush clean. Rinse system with low conductivity water or deionized water after sterilization until all traces of chlorine are eliminated. Notify the Berkeley Lab EH&S Project Manager ten (10) days prior to rinsing the system. It shall be the Contractor's responsibility to clean the piping system of all debris and visible contaminants. Perform all the above requirements in the presence of the Berkeley Lab EH&S Project Manager or their designated representative.

3.5 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other devices necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps.
- C. If a cleanout or check valve has not been installed at the easement or property line, then the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation within five (5) feet of the foundation wall, then a cleanout shall be provided and installed.
- D. If the building lateral exits the foundation under an existing deck or concrete patio, then the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner and the Engineer.

3.6 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing, regardless of whether corrections were necessary, and include in the transmittal; two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each (reproducible Dayrex mylar film positives) and AutoCAD 2015 files on a compact disc (CD).
- C. As-built drawings should indicate the following information at a minimum:
 - 1. Indicate all changes to the Contract Documents.
 - 2. Remove Engineer's seal, name, address, and logo from the drawings.
 - 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 - 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.

5. Indicate all changes to construction during the construction process.
6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
10. Indicate all changes with clouding around said changes.

END OF SECTION 22 05 12

SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Expansion joints
 - 2. Pipe alignment guides
 - 3. Pipe anchors
- B. Related Sections:
 - 1. 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
 - a. Product and installation requirements for piping hangers and supports.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints shall adequately provide protection of the system.
- B. Expansion compensation design criteria:
 - 1. Installation temperature: fifty (50) degrees Fahrenheit
 - 2. Domestic hot water: one hundred and forty (140) degrees Fahrenheit
 - 3. Safety factor: thirty (30) percent

1.4 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Shop drawings: indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered Professional Engineer.
- C. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion joints: indicate maximum temperature, pressure rating, and expansion compensation.

- D. Submit calculations of the design data indicating calculation criteria and sealed by a registered Professional Engineer.
- E. Submit special procedures as required by the manufacturer's installation instructions.
- F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.
- G. Submit welders' certificate indicating compliance with all American Welding Society (AWS) D1.1 "Structural Welding Code - Steel Endorsement Description" requirements.
- H. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.
- I. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.5 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 - General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with ASME B31.9 "Building Services Piping" for installation of piping systems and ASME BPVC-IX "Welding, Brazing, and Fusing Qualifications" for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.8 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints onsite in factory packing with shipping bars and positioning devices intact. Inspect for damage.

- B. Protect equipment from exposure by leaving factory coverings, pipe end protections, and packaging in place until installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.
- B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.2 EXPANSION JOINTS

- A. Acceptable manufacturers:
 - 1. VMC/Amber Booth
 - 2. Triplex
 - 3. Mason Industries
 - 4. Uponor
- B. Stainless steel bellows type:
 - 1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
 - 2. Maximum compression: one and three-quarters (1.75) inch
 - 3. Maximum extension: one-quarter (0.75) inch
 - 4. Joint: provide as specified for pipe joints
 - 5. Size: provide as per pipe size
 - 6. Application: steel piping three (3) inches and smaller
- C. External ring controlled stainless steel bellows type:
 - 1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
 - 2. Maximum compression: fifteen-sixteenths (0.9375) inch
 - 3. Maximum extension: five-sixteenths (0.3125) inch
 - 4. Maximum offset: one-eighth (0.125) inch
 - 5. Joint: flanged
 - 6. Size: provide as per pipe size

7. Accessories: internal flow liner
 8. Application: steel piping three (3) inches and larger
- D. Double sphere flexible type:
1. Construction: multi-layered Kevlar tire cord fabric reinforced with peroxide-cured EPDM cover, liner, and fabric frictioning
 2. Pressure rating of two hundred and fifteen (215) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit
 3. Maximum compression: one and one-quarter (1.25) inch permissible compression for up to six (6) inch pipe size; one and one-half (1.5) inch permissible compression for eight (8) inch pipe size and up to twelve (12) inch pipe size; one and one-fifth (1.2) inch permissible compression for fourteen (14) inch pipe size.
 4. Maximum elongation: three-quarters (0.75) inch permissible elongation for up to six (6) inch pipe size; one and one-half (1.5) inch permissible elongation for eight (8) inch pipe size and up to twelve (12) inch pipe size; five-eighths (0.625) inch permissible elongation for fourteen (14) inch pipe size.
 5. Maximum offset: three-eighths (0.375) inch permissible offset for up to six (6) inch pipe size; seven-eighths (0.875) inch permissible offset for eight (8) inch pipe size and up to twelve (12) inch pipe size; one (1) inch permissible offset for fourteen (14) inch pipe size.
 6. Maximum angular movement: fifteen (15) degrees
 7. Joint: steel or ductile iron flanges
 8. Size: provide as per pipe size
 9. Accessories: control rods
 10. Application: steel piping three (2) inches and larger
- E. PEX-a pipe support:
1. For use with Uponor PEX-a pipe
 2. Continuously support PEX-a piping with manufacturer approved pipe support systems and utilize fixed anchor points every:
 - a. Sixty-five (65) feet for domestic hot water
 - b. One hundred and fifty (150) feet for domestic cold water
 3. Utilize manufacturer-provided stainless steel straps to secure the PEX-a pipe supports to the pipe at the intervals specified in the manufacturer's installation instructions.
 4. Refer to the Uponor "Plumbing Design Assistance Manual" (PDAM) for more information.

2.3 ACCESSORIES

- A. Acceptable manufacturers:

1. VMC/Amber Booth
 2. Triplex
 3. Mason Industries
- B. Pipe alignment guides: two-piece welded steel, bolted, with enamel paint and with spider to fit standard pipe; frame with four mounting holes; clearance for minimum of one (1) inch thick insulation; minimum of three (3) inches for travel.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine piping layout and notify the Architect and Engineer of additional anchors or expansion joints required to adequately protect the system.
- B. Provide inspection services by the flexible pipe manufacturer's designated representative for final install and certify that the installation is in accordance with the manufacturer's recommendations as well as that the connectors are performing satisfactorily.

3.2 INSTALLATION

- A. Install work in accordance with ASME B31.9 "Building Services Piping" and any applicable local codes.
- B. Install piping to allow for expansion and contraction without stressing piping, joints, or connected equipment.
- C. Flexible piping shall not be used in concealed spaces. Access panels shall be provided for concealed space installations.
- D. Provide supports and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints or expansion joints where required. Refer to Section 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT for pipe hanger installation requirements.
- E. Provide grooved piping systems with a minimum of one (1) joint per inch of pipe diameter instead of flexible connectors supported by vibration isolation. Grooved piping systems need not be anchored.
- F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to the isolated equipment and anchor the other end.
- G. Provide expansion loops as per the pipe manufacturer's design guidelines or as indicated on the Drawings. Rigidly anchor pipe to the building structure where necessary and as required. Provide pipe guides so that movement takes place along the pipe's axis only. Rigidly anchor pipe to the building structure to prevent stress, strain, and loading transfer to connected equipment.
- H. Coordinate with the installation of piping seismic braces so that they do not interfere with thermal expansion loop action or building joint loop action.
- I. Install expansion compensating devices for PEX-a piping in accordance with the manufacturer's installation instructions.

END OF SECTION 22 05 16

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. Erico Caddy.
 - 3. PHP System.
 - 4. Anvil/Anvil Strut.
 - 5. BLINE.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - a. Provide at all system stub-ups from below grade thru ground floor slab.
 - 8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 12. Non-metallic pipe support: Vinyl-coated Hangers.
 - 13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
 - 14. Galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Galvanized steel to be used for outdoor installation.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.

- 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.

- B. Supports for Gas Piping:
1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Supports for Cast Iron Piping:
1. Vertical Piping:
 - a. Support vertical piping and tubing at base and at each floor.
 - b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
 - c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
 2. Horizontal Piping, Suspended:
 - a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
 - b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
 - c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
 - d. An anchor or bracing to be provided on all storm drain pipe fittings.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
- D. Supports for copper tubing:
1. The following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

- e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
 - 2. Install supports for vertical copper tubing every 10 feet (3 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- E. Supports for steel piping:
 - 1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- F. Supports for stainless-steel piping:
 - 1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- G. Supports for CPVC piping:
 - 1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

- f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
- H. Supports for PEX tubing:
 1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
 - b. 3/4" and smaller: 72 inches when a continuous support channel is used.
 - c. 1" and larger: 96 inches when a continuous support channel is used.
 2. Support vertical piping and tubing at base and at each floor.
 3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
 4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.
- I. Supports for PVC piping:
 1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PVC piping every 48 inches (1200 mm).
 3. Support vertical piping and tubing at base and at each floor.
- J. Supports for PP piping:
 1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod
 2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- K. Supports for insulated piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- L. Supports for Vertical-Piping
1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- M. Design hangers for pipe movement without disengagement of supported pipe.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- C. 22 05 00 - COMMON WORK RESULTS FOR PLUMBING
- D. 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- E. 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- F. 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- G. 22 20 23 - GAS PIPING

1.2 SUMMARY

- A. It is the intent of this Section to provide vibration isolation supports for all equipment and piping as it may be required to prevent transmission of vibration to the building structure. It shall be the Contractor's responsibility to select and install vibration isolators which shall meet the specified noise criteria standards to the extent that the noise can be controlled by the vibration isolators.

1.3 REFERENCES

- A. International Code Council (ICC) "International Building Code"

1.4 PERFORMANCE REQUIREMENTS

- A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- B. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of one-half (0.5) horsepower and larger. Deflections as tabulated are minimums and it shall be the vibration isolator manufacturer's responsibility to determine the amount of spring deflection required for each isolator to achieve optimal performance in preventing transmission of objectionable vibrations and in meeting the noise criteria standards referenced herein.
- C. Unless otherwise noted, equipment driven by motors one-quarter (0.25) horsepower and smaller shall be isolated by means of type "ND" elastomeric mounts or type "HD" elastomeric hangers properly sized for seven-twentieths (0.35) inch deflection.
- D. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and antioxidant additives.
- E. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

- F. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of thirty (30) pounds per square foot. Wind loads shall be applied to all exposed surfaces of the isolated equipment to identify worst-case scenario loads.
- G. All spring isolators shall be completely stable in operation and shall be designed for not less than fifty (50) percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a K_x and K_y anisotropic ratio of at least 1:1.
- H. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory-certified data. Any variance or non-compliance with these Specification requirements shall be corrected by the Contractor at no additional cost to the Owner. The manufacturer may purchase other manufactured products to meet this Specification and shall guarantee outsourced products as a single point of responsibility. Outsourced products shall be identified as such in the submittal for approval.
- I. The Contractor and manufacturer of the isolation devices and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- J. Deflection information is based on maintaining rooms at the following maximum sound levels, denominated in Noise Criteria (NC) as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American National Standards Institute (ANSI) S1.8 "Reference Values for Levels used in Acoustics and Vibrations" requirements.

RECOMMENDED NOISE CRITERION			
CATEGORY	TYPE OF ROOM	NOISE CRITERION LEVEL	EQUIVALENT SOUND LEVEL
		NC	dB_A
Offices	Conference rooms	25 - 30	35 - 40
Offices	Private	30 - 35	40 - 45
Offices	Open-plan areas	35 - 40	45 - 50
Offices	Business machines, computers	40 - 45	50 - 55
Offices	Circulation	35 - 40	45 - 50
Schools	Lecture and classrooms	25 - 30	35 - 40
Schools	Open-plan classrooms	35 - 40	45 - 50
Libraries	Libraries	35 - 40	40 - 50
Theaters	Theater	20 - 25	30 - 35
Theaters	Stage house	20 - 25	30 - 35
Theaters	Trap room	20 - 25	30 - 35
Theaters	Orchestra pit	20 - 25	30 - 35
Theaters	Rehearsal rooms	20 - 25	30 - 35
Theaters	Teaching studios	25 - 30	35 - 40
Theaters	Practice rooms	25 - 30	35 - 40
Theaters	Ensemble rooms	25 - 30	35 - 40
Theaters	Set shop	40 - 45	50 - 55

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Shop drawings: indicate inertia bases and locate vibration isolators with static and dynamic loads annotated on each instance. Indicate assembly, materials, thicknesses, dimensional data, layouts, and connection details. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Product data:
 - 1. Submit schedule of vibration isolator types with locations and loads on each instance. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Submit calculations of the design data indicating maximum room sound levels are not exceeded.
- E. Submit special procedures as required by the manufacturer's installation instructions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.
- G. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.
- H. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 QUALITY ASSURANCE

- A. Testing agency qualifications: independent agency with the experience and capability to conduct the testing indicated. Agency shall be certified as a Nationally Recognized Test Laboratory (NTRL) as defined by Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory" as well as certified by the local authorities having jurisdiction.
- B. Welding qualifications: qualify procedures and personnel according to American Welding Society (AWS) D1.1/D1.1M "Structural Welding Code - Steel" requirements.
- C. All plumbing systems' vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

- A. All vibration isolators described in this Section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Section 22 05 48.13, Subsection 1.4 "PERFORMANCE REQUIREMENTS" and the information below.

B. Acceptable manufacturers:

1. VMC/Amber Booth
2. Mason Industries
3. Kinetics Noise Control
4. Vibration Eliminator Company

C. Type "WSW"

1. Two (2) layers of three-eighths (0.375) inch thick neoprene pad consisting of square waffle modules separated horizontally by a sixteen (16) gauge galvanized shim. Where the load bearing area of the equipment is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of three twenty-fifths (0.12) inch up to four twenty-fifths (0.16) inch.

D. Type "ND"

1. Neoprene mountings shall have minimum static deflection of seven-twentieths (0.35) inch. All metal surfaces shall be neoprene covered and have friction pads at both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment, such as small vent sets, to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized.

E. Type "SLF"

1. Spring isolators shall be free-standing and laterally stable without any housing and complete with a molded neoprene cup or one-quarter (0.25) inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed height and operating height shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than four-fifths (0.8). Springs shall have minimum additional travel to solid equal to fifty (50) percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height, and solid spring height.

F. Type "SLR"

1. Restrained spring mountings shall have an "SLF" mounting as described in Subsection 2.1.E "Type 'SLF'" and within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and the spring to avoid interference with any spring action. Limit stops shall be out of contact during normal operation. Since housings are bolted or

welded in position under outdoor equipment, there shall be an internal isolation pad in addition to the friction pad on the bottom.

G. Type "HD"

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers.

H. Type "30N"

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element at the top and a steel spring as described in Subsection 2.1.E "Type 'SLF'" and seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene molded bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers, nor shall the neoprene element be stacked on top of the spring. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a thirty (30) degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the thirty (30) degree arc capability.

I. Type "PC30N"

1. Hangers shall be as described in Subsection 2.1.H "Type '30N'" but shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up stop to keep piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a hanger drawing showing the thirty (30) degree capability.

J. Type "WBI/WBD"

1. Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup as described in Subsection 2.1.E "Type 'SLF'" and with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be present for thrust at the factory and adjusted in the field to allow for a maximum of one-quarter (0.25) inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached to the centerline of thrust and symmetrical on either side of the unit.

K. Type "SLR-MT"

1. Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable and flexible nylon (Kevlar) reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of three (3) hertz. Air springs shall be designed for a burst pressure that is a minimum of three (3) times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that

includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and air springs to avoid interference with any air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three (3) leveling valves to maintain level within plus or minus one-eighth (0.125) inch. Air spring mounts shall be located between the supporting steel and the roof, or the grillage and dunnage as shown on the Drawings when there is no provision for direct mounting. Submittals shall include natural frequency and tests for load and damping performed by an independent lab or acoustician.

2.2 BASES

A. Type "WF"

1. Welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be "T" or "L" shaped. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to one-tenth (1/10) of the longest dimension of the base. Base depth need not exceed fourteen (14) inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

B. Type "ICS"

1. Vibration isolation manufacturer shall provide steel members welded to height savings brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion and misalignment of equipment.

C. Type "RBMK"

1. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, steel formed bases, and sheet metal formed bases shall not be acceptable. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. Bases may be "T" or "L" shaped where space is a problem. Bases shall be a minimum of one-twelfth (1/12) of the longest dimension of the base but not less than six (6) inches. Base depth need not exceed twelve (12) inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include concrete reinforcement consisting of bars that are a minimum of one-half (0.5) inch and welded in place on six (6) inch centers, running both ways in a layer of one and one-half (1.5) inch above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Type "SFDEJ," "SFEJ," "SFDJR," "SFU," and "CR" (control rods):

1. Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions shall have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out.
2. Flexible cable wire shall not be acceptable.
3. Sizes one and one-half (1.5) inch through fourteen (14) inches shall have a ductile iron external ring between the two spheres.
4. Sizes sixteen (16) inches through twenty-four (24) inches may be a single sphere.
5. Sizes three-quarters (0.75) inch through two (2) inches may be a single sphere, bolted threaded flange assemblies and cable retention.
6. Minimum ratings through fourteen (14) inches shall be two hundred and fifty (250) PSI at one hundred and seventy (170) degrees Fahrenheit and two hundred and fifteen (215) PSI at two hundred and fifty (250) degrees Fahrenheit.
7. Minimum ratings for sixteen (16) inches through twenty-four (24) inches shall be one hundred and eighty (180) PSI at one hundred and seventy (170) degrees Fahrenheit and one hundred and fifty (150) PSI at two hundred and fifty (250) degrees Fahrenheit.
8. Higher published rated connectors may be used where required.
9. Safety factors shall be a minimum of three hundred (300) percent. All expansion joints shall be factory tested to one hundred and fifty (150) percent of maximum pressure for twelve (12) minutes before shipment.
10. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through one-half (0.5) inch thick neoprene washer bushings large enough to take the thrust at one thousand (1000) PSI of surface area may be used on unanchored piping where the manufacturer determines the conditions exceed the expansion joint rating without them.
11. Submittals shall include two (2) test reports by independent consultants showing minimum reductions of twenty (20) decibels in vibration accelerations and ten (10) decibels in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.
12. All expansion joints shall be installed on the equipment side of the shut-off valves.

2.4 MECHANICAL ANCHOR BOLTS

- A. Drilled-in and stud-wedge type or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 "Standard Test Methods for Strength of Anchors in Concrete Elements" requirements. The stud anchors shall have an evaluation report number from the ICC-ES verifying its allowable loads.

2.5 ADHESIVE ANCHOR BOLTS

- A. Drilled-in and capsule anchor system containing polyvinyl chloride or urethane methacrylate-based resin and accelerator; or an injected polymer; or a hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 "Standard Test Methods for Strength of Anchors in Concrete Elements" and ICC-ES AC308 "Post-installed Adhesive Anchors in Concrete Elements" requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the work required.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations prior to installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

- A. Horizontal piping:
 - 1. Isolate all pumped water, pumped condensate, and refrigerant piping sizes one and one-quarter (1.25) inch and larger within mechanical rooms and pipe sizes two (2) inches and larger outside mechanical rooms shall also be isolated. Outside equipment rooms, this piping shall be isolated for the greater of fifty (50) feet or one hundred (100) pipe diameters from externally isolated equipment. For the first three (3) support locations from the externally isolated equipment, provide Type "30N" hangers or Type "SLF" floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a one (1) inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping yet also permitting piping to function as a floating system. Size hangers for two hundred (200) percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Riser piping:
 - 1. Isolate all vertical pipe risers one and one-quarter (1.25) inch and larger, where specifically shown and detailed on riser diagrams, shall be fully supported by Type "SLF" mounts with precompression plates and brackets. Refer to manufacturer's details for additional information. Steel spring deflection shall be three-quarters (0.75) inch minimum. In locations where added deflection is required due to pipe expansion and contraction, the spring deflection shall be a minimum of four (4) times the anticipated movement to prevent binding. Provide Type "SWS" wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations shall show anticipated expansion and contraction at each support point, initial and final loads on the build structure, and spring deflection changes. Submittal data shall include

certification that the piping system has been examined for excessive stresses and that none exist in the proposed design.

3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points as well as with requirements for concrete reinforcement and formwork as specified in Division 03.
- B. Installation of vibration isolators shall not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near to the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below the base is provided when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and ensure that units are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices, if any, intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for anchor bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to walls.
- K. If specific attachment to structure is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical conduit, telecommunications conduit, and gas lines.
 - 2. Drilling holes in concrete or masonry prior to concrete, mortar, or grout achieving full design strength shall not be acceptable.
 - 3. At wedge anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.

4. At adhesive anchors, clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes beginning at the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections. Coordinate with the Owner, through the Architect, for additional requirements prior to engaging the test.
- B. Perform tests and inspections as required and as indicated below:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to the authorities having jurisdiction.
 2. Schedule test with the Owner, through the Architect, prior to connecting anchorage devices to restrained components (unless post-connection testing has been approved) and with at least seven (7) days of advance notice.
 3. Obtain the Architect's approval prior to transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test a minimum of four (4) installed anchors and fasteners of each type and size as selected by the Architect. Provide additional testing of more anchors if instructed by the Owner or Architect.
 5. Test to ninety (90) percent of the rated proof load of device.
 6. Measure isolator restraint clearance and isolator deflection.
 7. Verify snubber minimum clearances.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops to they are out of contact during normal operation.

END OF SECTION 22 05 48.13

SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. It is the intent of this Section to provide requirements for commissioning of plumbing systems, subsystems, and equipment. This Section supplements the general requirements specified in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.
- C. The requirements of this Section shall apply to all Sections of Division 22.
- D. This project shall have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor shall be responsible for executing, is defined in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) shall be appointed by the Owner or the Owner's representative.
- E. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for definitions and additional information.

1.3 REFERENCES

- A. Division 01 Specification Sections
- B. 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS
- C. 01 33 00 - SUBMITTAL PROCEDURES

1.4 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel in accordance with the requirements of Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and of Division 22, is required in cooperation with the Owner and the CxA.
- B. The plumbing systems commissioning will include the systems listed in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.5 SUBMITTALS

- A. The commissioning process requires review of selected submittals. The CxA shall provide a list of submittals that shall be reviewed by the CxA. This list shall be reviewed and approved by the Owner prior to forwarding to the Contractor. Refer to Section 01 33 00 - SUBMITTAL PROCEDURES for further details.

- B. The commissioning process requires review of submittals simultaneously with engineering review. Specific submittal requirements related to the commissioning process are as specified in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (N/A)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of the building plumbing systems shall require inspection of individual elements of the plumbing construction throughout the construction period. The Contractor shall coordinate with the CxA in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and the commissioning plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete pre-functional checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for systems functional performance testing. The CxA will prepare pre-functional checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the CxA for review. The CxA may spot check a sample of completed checklists. If the CxA determines that the information provided on the checklists is not accurate, the CxA will return the checklist with markups to the Contractor for correction and resubmission. If the CxA determines that a significant number of completed checklists for similar equipment are not accurate, the CxA will select a broader sample of checklists for review. If the CxA determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.

3.3 CONTRACTOR TESTS

- A. Contractor tests, as required by other Sections of Division 22, shall be scheduled and documented in accordance with Division 01. All testing shall be incorporated into the project schedule. The Contractor shall provide no less than seven (7) days of advance notice of testing. The CxA will witness selected Contractor tests at the sole discretion of the CxA. Contractor tests shall be completed prior to scheduling systems functional performance testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The commissioning process includes systems functional performance testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and to test system performance under emergency conditions. The CxA will prepare detailed systems functional performance test procedures for review and approval by the Engineer. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The CxA will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for additional information.

3.5 TRAINING OF OWNER PERSONNEL

- A. Training of the Owner's operation and maintenance personnel shall be required in cooperation with the Engineer and CxA. Provide competent, factory-authorized personnel to provide instruction to the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and Sections of Division 22 for additional Contractor training requirements.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K.
 - 1. Fittings: ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.
- B. PEX-a Tubing: ASTM F876/F877, AWWA C904
 - 1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
 - 2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 6" and smaller: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Appurtenances for Grooved-End Copper Tubing:
 - 1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
 - a) Victaulic
 - 2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3) Mechanical Couplings for Grooved-End Copper Tubing:
 - a) Copper-tube dimensions and design similar to AWWA C606.
 - b) Ferrous housing sections.
 - c) EPDM-rubber gaskets suitable for hot and cold water.
 - d) Bolts and nuts.
 - e) Minimum Pressure Rating: 300 psig.
 - 3. At the contractor's option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services piping -20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect

feature to identify unpressed connections during system testing. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

- a. The only approved manufacturer:
 - 1) Viega
- B. CPVC: Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a cell class per ASTM D 1784 and listed by ICC to ASTM E84, similar to SPEARS EVERTUFF CTS or approved equal.
 1. Pipe & Fittings = ASTM D 2846. All pipe and fittings shall be manufactured in the United States and shall conform to National Sanitation Foundation (NSF) Standards 14 and 61.
 2. Joints = ASTM F 493, solvent cements for CPVC pipe and fittings.
 3. Installations = Comply with the latest installation instructions published by manufacturer and shall conform to all applicable plumbing, fire and building code requirements. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with CPVC compounds.
 4. The system shall be hydrostatically tested after installation.
- C. Pipe 2" and smaller (NON-EXPOSED): PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5) by Uponor and tested for compliance by an independent third party agency.
 1. Type: Wirsbo AQUAPEX. Standard grade hydrostatic design and pressure ratings from PPI. Fire-rated assembly listings in accordance with ANSI/UL 263.
 2. Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - a. UNS No. C69300 Lead-free (LF) Brass
 - b. UNS No. C27453 Lead-free (LF) Brass
 - c. 20% glass-filled polysulfone as specified in ASTM D 6394
 - d. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394
 - e. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394
 - f. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394
 - g. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960"
 3. Accessories: Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer. The tubing manufacturer provides clips and/or PE
 4. X rails for supporting tubing runs. All horizontal tubing hangers and riser clamps are epoxy-coated material.
 5. PEX-to-Metal Transition Fittings:
 - a. Manufacturers: Provide fittings from the same manufacturer of the piping.
 - b. PEX-a to Threaded Brass Transition: One-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - c. PEX-a to Brass Sweat Transition: One-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

- d. PEX-a to Flange Transition: Two-piece fitting with one steel flange conforming to ASME B 16.5 and one lead free (LF) brass adapter conforming to ASTM F 1960.
- e. PEX-a to Groove Transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- f. PEX-a to Water Meter Transition: Two-piece fitting with one NPSM union thread and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- g. PEX-a to Copper Press Transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- 6. PEX-to-Thermoplastic Transition Fittings:
 - a. PEX-a to CPVC Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- D. PEX-a Tubing 3" : ASTM F876/F877
 - 1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
 - 2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.
 - 3. Basis of design Uponor AquaPEX pipe and ProPEX engineered polymer or lead-free brass fittings. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Pipe Size 2-1/2 inches and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
 - 3. PEX-a tube and pipe: Class 150 ASME B16.5 flanges; ASTM F1960 joints.

2.5 GALVANIC PROTECTION

- A. Dissimilar piping material connections shall not be made without an approved dielectric union.
- B. Dielectric Connections:
 - 1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
 - 2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.

2.6 VALVES

A. General

1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

B. Ball Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
2. Two (2) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Ball Valves for PEX-a Two (2) inches and smaller: NSF 359, Class 150, 250 psi CWP, forged brass, two piece body, brass ball, Teflon (PTFE) seats, blow-out proof stem, lever handle, ASTM F1960 ends. No Lead. Basis of design Uponor Lead-free Commercial Ball Valves.
6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
2. Line Shut-Off Valves 2-1/2" to 3" where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
3. Line Shut-Off Valves 4" and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 CWP ductile iron body gate valve with non rising stem, resilient wedge, flange ends, EPDM liner and seal. Acceptable valves are NIBCO Model F-619-RWS/SON, or approved equal.
4. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

- D. Swing Check Valves:
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - 2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
 - 3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.
- E. Balancing Valves (Hot Water Recirculation)
 - 1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
 - 2. Balancing valves shall be IMI Flow Design model UA Zero series (0.5 to 1.5 GPM venturi range) or approved equal by ITT or Bell and Gossett. Provide extended handle as required.
 - 3. Ball valves are not acceptable for balancing the hot water return system.
 - 4. Provide a ball valve (for isolation purposes) and a strainer immediately upstream of the balancing valve, and then provide a check valve and ball valve (for isolation purposes) immediately downstream of the balancing valve. Valves and appurtenances shall be sized in accordance with the hot water return line size.

2.7 STRAINERS

- A. Manufacturer: Watts, Crane or approved equal.
- B. Two (2) inches and Smaller: Threaded (lead free) cast copper silicon alloy for 400 PSI WOG, wye pattern with 1/32 inch stainless steel perforated screen. Watts Series LF777.
- C. 2-1/2 and Larger: Class 125, flanged (lead free) cast iron strainer for 200 PSI WOG, wye pattern with 1/16-inch stainless steel perforated screen. Watts Series 77F-DI-125.
- D. Lead Free.

2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
 - 1. Weiss
 - 2. Marsh Bellofram
 - 3. Weksler
 - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.
 - 3. Dial Size: 4-1/2 diameter.
 - 4. Mid-Scale Accuracy: One (1) percent.
 - 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.

- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.
- Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
- AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
- BB. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.
- CC. Lead Free.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.
- C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 INSTALLATION - PRESSURE GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in "Permits" under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.

- E. Installers for PEX-a piping shall have completed the applicable training courses per manufacturer's requirements.
- F. Cleaning of piping systems:
 - 1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
 - 2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
 - 3. Phase One: Initial flushing of system.
 - a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Phase Two: Cleaning of Piping Systems:
 - a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
 - b. Flush system and replace with clean water.
 - 5. Phase Three: Final flushing and rinsing:
 - a. Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 6. Submit status reports upon completion of each phase of work on each system.
- G. Branch Connections:
 - 1. Pipe 2" and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.
- H. 2-1/2" through 36". For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.
- I. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMP installation standards IS-9.
 - 3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
 - 4. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.
- B. Cast Iron Pipe (Hub):
 - 1. ASTM - A 74, hub and spigot DWV pipe and fittings with neoprene compression gasket joints for all buried pipe. Cast iron soil pipe, fittings and hub gaskets shall be manufactured by Tyler Pipe, AB & I foundry or Charlotte Pipe and Foundry. All cast iron pipe and fittings shall be of the same manufacturer.
- C. Cast Iron Pipe (No Hub):
 - 1. ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International (first 15'-0" section of dishwasher waste grease waste pipe):
 - 2. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 3. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.
 - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon, Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.

- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.
- B. Establish minimum separation from other services piping in accordance with code.
- C. Remove scale and dirt on inside of piping before assembly.
- D. Install with a uniform slope of not less than 1/4 of an inch per foot.
- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- F. Route pipe in straight line.
- G. Excavation:
 - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
 - 2. Cut the bottom of the trench or excavation to uniform grade.
 - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
 - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
 - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.

4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum or as required per the code if more stringent. All grease waste piping upstream of a grease interceptor shall be sloped to 1/4 inch per foot (two (2) percent) per code. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- D. Install a floor clean out according to the following:
 1. Not more than 40' apart in all horizontal drain lines.
 2. At each change of direction greater than 45 Deg.
 3. At the base of each waste or soil stack.
 4. Install floor cleanouts at elevation to accommodate finished floor.
 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waste lines.
- E. Install a wall cleanout according to the following:
 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals per code. Wall cleanout shall be flush with accessible side of wall.
 2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and drinking fountains.
 3. **Cleanouts in the wall shall be above the rim of the lowest fixture(s) being served to prevent the waste of the associated fixture(s) from discharging on the floor when maintenance needs to inspect and snake the line.**
- F. Install an exterior cleanout according to the following:
 1. Encase exterior cleanouts in concrete flush with grade.
 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect per code.

- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- I. Install piping to maintain headroom. Do not spread piping, conserve space.
- J. Group piping whenever practical at common elevations.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.
- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.

- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 13 21 - ACID WASTE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 PLUMBING SYSTEMS DESIGN CRITERIA AND SCOPE OF WORK

- A. SYSTEMS
 - 1. Systems to be provided under the Plumbing design section shall be as listed below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - a. Acid waste and vent piping systems.
 - b. Acid neutralization tanks.
- B. DESIGN STANDARDS
 - 1. Plumbing systems shall be designed and installed in accordance with the requirements of the following codes, standards and design guides:
 - a. The International Plumbing Code, 2012 Edition, with most current State of Texas Amendments
 - b. The International Building Code, 2012 Edition, with most current State of Texas Amendments
 - c. Americans with Disabilities Act (ADA)
 - d. American Society of Plumbing Engineers (ASPE) Data Books
 - e. National Fire Protection Association (NFPA) Standards
 - 1) NFPA 30 - Flammable and Combustible Liquids Code
 - 2) NFPA 58 - Liquefied Petroleum Gases
 - f. Plumbing Drainage Institute (PDI)
 - g. Underwriters Laboratories Inc. (UL)
 - h. National Sanitation Foundation (NSF)
 - i. Local and State Fire Marshal requirements
 - j. Local Building and Inspection Department requirements
 - k. Local Health Department requirements

1.3 GENERAL REQUIREMENTS

- A. Division 1, General Requirements and Supplementary Conditions, are hereby made a part of this section as fully as if repeated herein.
- B. The scope of work required by this section of the specifications consists of furnishing all materials, labor, supervision, equipment, appurtenances, accessories, connections, permits and services to perform all plumbing work, complete and placed into approved operating condition, including all tests and adjustments, in strict accordance with these specifications and the Contract Drawings.
- C. The principal work under this section shall include, but not be limited to the following systems and equipment:
 - 1. The Contractor shall furnish and install acid waste and vent piping and dilution basins as indicated on the drawings and/or included in this division of these specifications.
 - 2. Underground acid waste and vent piping including mains, branches, traps, connections to fixture and drains, and connections to stacks, piping to dilution tank; dilution tank(s) and piping connections from tank to designated outfall structure.
- D. The drawings and these specifications are complimentary each to the other, and any labor, or material called for by either, whether or not by both, shall be furnished and installed. The Contractor shall notify the Architect/Engineer of any discrepancies between the drawings and specifications regarding labor or materials prior to submitting bid.
- E. The drawings are diagrammatic in nature and indicate the various systems and piping required. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The plumbing subcontractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions. Particular attention shall be taken to avoid foundations, footing and other structural elements furnished under other sections of the specifications. Any adaptations, modifications, or additions are the responsibility of and shall be borne by this subcontractor and shall be approved by the Engineer before execution. All openings, blockouts or sleeves required for the execution of this subcontract are the responsibility of this subcontractor to coordinate.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and backfill for installation of the specified systems shall be done by this subcontractor.
- B. Core drilling, masonry work and painting incidental to the installation of the specified systems shall be included in the scope of work of this subcontractor.

1.5 REFERENCES

A. Codes, Ordinances and Permits

1. All work performed under this section of the Specifications shall conform to all codes, ordinances, and regulations of the City, County, State and/or other authorities having jurisdiction. All work shall conform to the 2000 Standard Plumbing Code with all local amendments as a minimum.
2. This subcontractor shall give proper authorities all requisite notices, file all required plans relative to the work specified herein with proper authorities, and secure and pay for all permits, licenses and certificates relating to his work.
3. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.6 SUBMITTALS

A. Shop Drawings and Catalog Data

1. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials, and within 30 days from date of contract award. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
 - a. Acid waste and vent piping.
 - b. Acid neutralization tank
2. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.
3. Review of shop drawings by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc. Such coordination shall be clearly indicated on the shop drawings.
4. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

1.7 EQUIPMENT, MATERIAL BID BASIS

- ### **A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.**

- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in specifications or on drawings as "base" products.
- C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

1.8 EXAMINATION OF PREMISES

- A. Prior to the ordering or purchasing of any plumbing equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the existing conditions under which he will be required to operate, or that will in any manner affect the work under this Contract.

1.9 EXISTING SERVICES

- A. If existing active services are encountered that require relocation, notify the Architect and relocate as directed. Do not prevent or disturb operation of active services that are to remain.

1.10 COORDINATION OF TRADES

- A. The plumbing subcontractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. This subcontractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. This subcontractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, this subcontractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. This subcontractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

- F. Plumbing work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.11 OBTAINING AND GIVING INFORMATION

- A. Obtain detailed information from all manufacturers as to the proper method of installing and connecting same. Obtain all required information necessary to facilitate and complete the plumbing installation.
- B. Coordinate the shape, size and position of all openings required for materials and equipment under this section and give full information to other trades sufficiently in advance to allow proper access requirements. Provide all sleeves and supports necessary to complete the work specified under this section.
- C. In case of failure on the part of this subcontractor to give proper information as noted above, all necessary cutting and patching will be performed at this subcontractor's expense.
- D. The information to be furnished by this subcontractor shall include sleeve openings (sizes and locations) and all other pertinent information relative to the plumbing installation. This subcontractor shall also furnish to other trades the dimensions and weights of all major pieces of mechanical equipment, and schedule with other trades the clearances that will be required throughout the building to allow for the passage of same through the building to their required installation locations.

1.12 OPERATING INSTRUCTIONS

- A. This subcontractor shall give detailed instructions for a period of not less than one-half days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.
- B. Prior to final acceptance by the Owner, this subcontractor shall submit a complete as-built submittal to the Engineer for review, three (3) sets of operating and instructional manuals, spare parts lists, drawings, wiring diagrams, trouble shooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.
- C. A complete set of reproducible as-built drawings shall be provided indicating the location of all concealed piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.
- D. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

1.13 GUARANTEE

- A. Guarantee for all work furnished and/or installed under this section shall be as specified in Division 1 or a minimum of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 PIPING SYSTEMS

- A. General
 - 1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on drawings.
- B. Underground Pipe and Fittings
 - 1. Pipe sizes 1-1/2" to 6": Polypropylene, Schedule 40, DWV type ASTM F-1412, with recessed drainage fittings, ASTM "D" 4101 and joints conforming to ASTM-2657.
 - a. Joints shall be mechanical type with heavy bituminous coating on exposed metal parts.
 - b. Joints shall be electric heat fusion type.
 - 2. Pipe sizes 1-1/2" to 6": ChemDrain® Chlorinated Polyvinyl Chloride (CPVC-cwd) schedule 40, non-pressure DWV type conforming to ASTM F2618.
 - a. Joints shall be solvent cemented per ASTM F2618.
 - 3. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- C. Aboveground Pipe and Fittings
 - 1. Pipe sizes 1-1/2" to 4": Polyvinylidene Fluoride (PVDF), flame retardant, schedule 40, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
 - a. Joints shall be mechanical type.
 - b. Joints shall be electric heat fusion type.
 - 2. Pipe sizes 1-1/2" to 4": Polypropylene Fluoride (PP), flame retardant, schedule 40, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
 - a. Joints shall be mechanical type.
 - b. Joints shall be electric heat fusion type.
 - c. Pipe to be fire wrapped in return air plenum.
 - 3. Pipe sizes 1-1/2" to 4": ChemDrain Chlorinated Polyvinyl Chloride (CPVC-cwd), schedule 40, non-pressure DWV type conforming to ASTM F-2618.
 - a. Joints shall be solvent cemented per ASTM F2618.
 - 4. Glass Pipe: ASTM C1053

- a. Fittings: ASTM C1053.
 - b. Joints: Stainless steel compression couplings with tetra-fluoroethylene seal ring.
 - c. Manufacturer: O-I/Schott Process Systems, Inc., "KIMAX".
- D. Floor Drains
 - 1. Corrosion resistant drain with sediment bucket and fiber-filled grate, Polyvinylidene Fluoride (PVDF), ASTM D4101, socket fusion or mechanical joint connection, Orion model AWFDSTD or approved equal.
- E. Floor Cleanout
 - 1. Corrosion resistant floor cleanout with countersunk plug, ASTM-D-4101, round nickel bronze cover, AWCO (acid waste cleanout) cast in cover, Orion model FCO-SQ or approved equal.
- F. Manufacturers
 - 1. Provide acid waste and vent piping and dilution tanks from one of the following:
 - a. Orion (Watts)
 - b. Chemtrol
 - c. Town & Country Plastics
 - d. George Fischer Sloane
 - e. Zurn Industries
 - f. Charlotte Pipe
 - g. Spears Mfg.
 - h. IPEX
 - i. Equal and owner approved
- G. Acid Waste Drainage Piping Materials and Products
 - 1. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in chemical drainage piping systems.
 - 2. Where more than one type of material or product is indicated, selection is Installer's option, however, systems of piping must remain consistent in the type of materials and fittings utilized.
 - 3. The Acid Dilution Basin shall be as indicated on the plumbing drawings.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS

- A. Waste, Vent and Indirect Waste Piping - General
 - 1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch

shall be allowed on main lines 4 inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.

2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the drawings.
3. The main ventilation stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3 feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.
4. Piping is to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.
5. Fire wrap non rating piping in return air plenum as required. Re section 22 05 29 for additional requirements.

3.2 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with 48 hours minimum notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by this subcontractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Acid Waste Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet head of water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested so that no joint of piping in the building except the uppermost 10 feet of the system shall be submitted to a test of less than a 10 foot of head water. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the

introduction of additional air for a period of at least 30 minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

D. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.3 EXCAVATION AND BACKFILL

- A. The Contractor shall do all necessary excavations for all piping, equipment and apparatus under this section and shall backfill trenches by filling and tamping in not more than 6" layers after pipes have been installed, tested and approved. Care shall be taken not to excavate below depth necessary. If excessive excavation is made or pipes are installed in filled areas, fill soil shall be tamped to compaction as specified under the Division 2 specifications. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- B. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 FIXTURE CONNECTIONS AND SUPPORTS

- A. Wall fixtures shall be hung by means of wall hangers supported by at least four (4) 3/8" lag bolts and expansion shields.

3.5 SLEEVES

- A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.6 INSTALLATION OF UNIONS

- A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.7 TRAPS

- A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.8 CLEANOUT INSTALLATION

- A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- B. Install a floor clean out according to the following:
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
- C. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
- D. Install a exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.

3.9 FLASHING INSTALLATION

- A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.
- B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

3.10 EQUIPMENT AND MATERIAL PROTECTION

- A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.11 SPACE REQUIREMENTS

- A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF SECTION 22 13 21

SECTION 22 15 13 - COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less. Make connections to compressor, dryer, filter, and other related items of equipment and piping accessories, and extend air piping through building to all equipment, fixtures and outlets requiring same.

1.4 SUBMITTALS

- A. Product Data for the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Flexible pipe connectors.
 - 3. Safety valves.
 - 4. Pressure regulators.
 - 5. Filters
 - 6. Automatic drain valves.
 - 7. Quick couplings.
 - 8. Hose assemblies.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SYSTEM DESCRIPTION

- A. Shop air operating at 125 psig (1200 kPa).

2.3 PIPES, TUBES AND FITTINGS

- A. Schedule 40, Galvanized steel Pipe: ASTM A 53.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded. Provide Class 300 and galvanized finish if indicated.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, threaded.
 - 4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.
 - 5. Forged-Steel Fittings: ASME B16.11, socket type.
 - 6. Steel Flanges: ASME B16.5, Class 150, carbon steel.
 - 7. Press-Connect Fittings: MegaPressG ANSI LC-4/CSA 6.32.
- B. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
 - 1. Manufacturers:
 - a. ANAMET Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Hyspan Precision Products, Inc.
 - e. Mercer Rubber Co.
 - f. Metraflex, Inc.
 - g. Proco Products, Inc.
 - h. Unaflex, Inc.
 - 2. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - a. Working-Pressure Rating: 200 minimum.
 - b. End Connections NPS 2 and Smaller: threaded Steel pipe nipple.

- c. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.4 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 VALVES

- A. Ball Valves:
1. 1/4 inch to one (1) inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70.
 2. 1-1/4 inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. Nibco T-580-70.

2.6 SPECIALTIES

- A. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
1. Manufacturers:
 - a. Aeroquip Corporation.
 - b. Bowes Manufacturing, Inc.
 - c. Foster Manufacturing Co., Inc.
 - d. Milton Industries, Inc.
 - e. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
 - f. Rectus Corp.
 - g. Schrader-Bridgeport; Amflo Div.
 - h. Schrader-Bridgeport/Standard Thomson.
 - i. Snap-Tite, Inc.
 - j. TOMCO Products Inc.
 - k. Tuthill Corporation; Hansen Coupling Div.
 2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - b. Plug End: Straight-through type with serrated outlet for attaching hose.
- B. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
1. Hose: double-wire-braid, CR-covered hose for compressed-air service.
 2. Hose Clamps: Stainless-steel clamps or bands.
 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the follow conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
 - 1. Notify Owner not less than seven (7) days in advance of proposed interruption of compressed-air service.

3.2 PIPING APPLICATIONS

- A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating use din applications below, unless otherwise indicated.
- B. Joining of Dissimilar Metal Piping: Use dielectric fittings.
 - 1. NPS 2 and Smaller: Dielectric unions.
 - 2. NPS 2-1/2 to NPS 4: Dielectric flanges.
 - 3. NPS 6 and Larger: Dielectric flange kits.
- C. Low-Pressure Compressed-Air Piping: Use the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron or press-connect fittings; and threaded or press-connected joints.
 - 2. NPS 6 to NPS 12: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

3.3 PIPING INSTALLATION

- A. Install air and drain piping with 1 percent slope downward in direction of airflow.
- B. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- C. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- D. Install flexible pipe connector on each connection to air compressors.
- E. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.

3.4 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

- C. Install pressure regulators on compressed-air piping where reduced pressure is required.
- D. Install flexible pipe connectors in discharge piping [and in inlet air piping from remote air-inlet filter] of each air compressor.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
 - 2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 3. Repair leaks and retest until no leaks exist.
 - 4. Report results in writing.

END OF SECTION 22 15 13

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. 2015 Edition of the International Fuel Gas Code.
 - 2. Latest Edition of NFPA 54, National Fuel Gas Code.
 - 3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.

- 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
- 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
 - d. Tape form pipe coating.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

- A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type or ANSI LC-4/CSA 6.32 press-connect type (Viega MegaPressG, NIBCO BenchPressG).
 - 2. Joints: ASME B31.9, welded or ANSI LC-4/CSA 6.32, press-connect.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Contractor Option: Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
 - 1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.
 - 2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

- A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

- B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.
- C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, ANSI LC-4/CSA 6.32 press-connect (Viega MegaPressG, NIBCO BenchPressG), or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, threaded joints only at the valves/ regulators or press-connected through 2" max size or welded to ASME B31.9 above 2" size.
 - 3. EXCEPTIONS:
 - a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
 - b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.6 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 VALVES

- A. Manufacturers:
 - 1. Apollo.
 - 2. NIBCO.
 - 3. Milwaukee.
 - 4. Watts.
 - 5. Homestead Valve.
- B. Ball Valves:
 - 1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.
 - 2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).

3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

- A. Manufacturers:
 1. O.C. Keckley Company or approved equal.
- B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

- A. Manufacturers:
 1. BelGas.
 2. Itron.
 3. Honeywell.
 4. Sensus.
 5. Maxitrol.
 6. Fisher.
- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.
 2. Body: Steel.
 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 4. Disk, diaphragm, and O-ring: Nitrile.
 5. Maximum inlet pressure: 150 psig
 6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

- A. Manufacturers:

1. Fisher 289H, or approved equal.
- B. Product Description: Spring loaded type relief valve.
 1. Body: Aluminum.
 2. Diaphragm: Nitrile.
 3. Orifice: Brass.
 4. Maximum operating temperature: 150 degrees Fahrenheit.
 5. Inlet Connections: Threaded.
 6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

- A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using "Scotchwrap," "CT Tapecoat" or "X-Tru-Tape." Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.13 EMERGENCY SHUT-OFF VALVE

- A. Laboratory Classrooms - See related section 22 30 00.
- B. Provide Emergency Earthquake Gas Shut Off Valves.

2.14 LABORATORY NATURAL GAS PIPING

- A. All natural gas piping serving labs from main natural gas riser shall be routed exposed to view below ceiling and painted in accordance with Division 09. (Delete this if is not required on school project).
- B. Install emergency gas shut-off valve in each line serving individual laboratory rooms. Locate (Emergency) shut-off actuator within lab area adjacent to each room exit at 54 inches above finished floor. Location of emergency shut-off shall be accessible to occupants for shutting off the natural gas supply under emergency conditions and comply with Texas Accessibility Standards Accessible Elements and Space requirements.
- C. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be BLC Lab Controls or approved equal.

- D. Gas piping joints shall be welded from main natural gas riser to each emergency shut-off valve. Piping from the emergency shutoff valve to the outlets shall be assembled with threaded fittings provided all joints are exposed to view or within the confines of laboratory furniture.
- E. Install flexible stainless steel appliance/equipment connector at each fume hood and biological safety cabinet requiring natural gas service. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

PART 3 - EXECUTION

3.2 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Establish minimum separation of gas pipe from other services, piping in accordance with code.
- C. Install continuous jacket or tape.
- D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- E. Install Work in accordance with Gas Company standards.
- F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.
- H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- H. Gas piping installed in plenums and chases shall be welded.
- I. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- J. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- K. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- L. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- M. Provide separate gas valves on each fixture in labs.
- N. Provide a gas isolation valve on the lab controller unit.
- O. Install a test port of each side of all natural gas pressure regulators.
- P. Perform a pressure test of all replaced natural gas piping.
- Q. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.
- R. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Section Includes:
 - 1. COMMERCIAL ELECTRIC WATER HEATERS
 - 2. VACUUM RELIEF VALVES
 - 3. IN-LINE CIRCULATORS
 - 4. T & P RELIEF VALVES
 - 5. DIAPHRAGM-TYPE EXPANSION TANKS
 - 6. GARBAGE DISPOSAL
 - 7. AIR COMPRESSOR
 - 8. ACID DILUTION TRAP
 - 9. LINT INTERCEPTOR - LT-1 (Central System up to 20 GPM)
 - 10. SAMPLING WELL
 - 11. BACKFLOW PREVENTERS
 - 12. WATER PRESSURE REGULATING VALVES
 - 13. WATER HAMMER ARRESTORS
 - 14. THERMOSTATIC MIXING VALVES
 - 15. SOLENOID VALVES

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.

- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

- A. Furnish two pump seals.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Bradford White.
 - 3. American Water Heater.
 - 4. Rudd.
 - 5. State.
 - 6. Rheem.
 - 7. PVI
 - 8. Lochinvar
 - 9. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.
- B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.
- C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.
- D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.

- E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.
- F. Water heater(s) shall be capable for remote monitoring, Controls, leak detection and fault alert.
- G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 3, 5, or 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- H. Capacity:
 - 1. Storage capacity: 10 gal or as indicated.
 - 2. Heating element size: 3 kW or as indicated.
 - 3. Number of heating elements: 1 or as indicated.
 - 4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
 - 5. Maximum working pressure: 160 psig.
 - 6. Provide integral heat traps.
 - 7. Provide drain pan.
- I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.7 VACUUM RELIEF VALVES

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. Taco
 - 3. Aurora
 - 4. Armstrong
 - 5. Grundfos
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.

- E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.
- F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- G. Drive: Flexible coupling.
- H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.
- I. Aqua-stat: Honeywell - Model L4006A1009 (100 - 240 degree range) or approved equal by Johnson Controls and Dayton.
- J. Timer: Armstrong - Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Armstrong

2.9 T & P RELIEF VALVES

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
 - 1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Bell & Gosset PT Series or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Provide separate support to structure for expansion tank

2.11 GARBAGE DISPOSAL

- A. Insinkerator Model 444, 120V, 3/4 HP, provide all trim and accessories for City approved installation.

2.12 AIR COMPRESSOR

- A. (AC-1): Champion Model No. VR5-12 (5HP/460/3/60) with vertical 120-gallon receiver with a R-15A compressor capable of delivering 16.5 CFM. Unit to be furnished with Model No. AD55 air dryer with a flow capacity as required. Coordinate with Electrical for electrical requirements. Provide unit with all motor control components including starter.
- B. Accessories:

1. Inlet-Air Filter: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
 - a. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - b. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
2. Flexible Connectors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Flex-Hose Co., Inc.
 - (2) Flexicraft Industries.
 - (3) Hyspan Precision Products, Inc.
 - (4) Mercer Rubber Co.
 - (5) Metraflex, Inc.
 - (6) Proco Products, Inc.
 - (7) Unaflex, Inc.
 - (8) efacqc
 - b. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - (1) Working-Pressure Rating: [**200 psig**] [250 psig] minimum.
 - (2) End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
 - (3) End Connections, NPS 2-1/2 and Larger: Flanged steel nipple
3. Filters: (10 scum - 170 SCFM)
 - a. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration and drain cock. [**Include mounting bracket if wall mounting is indicated.**]
 - b. Coalescing Filters/Regulator: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. [**Include mounting bracket if wall mounting is indicated.**]

2.25 ACID DILUTION TRAP

- A. Manufacturer: Striem, Zurn, Spears, Orion.
- B. Capacity: 2 gallons
- C. Construction:
 1. Tanks can be manufactured from polypropylene resin conforming to ASTM D-4101. These tanks can be used at temperatures up to 212°F in continuous service and in areas of high chemical concentration. Polypropylene tanks are translucent.
 2. Tank lids can be bolted or welded. Maintenance access ports can be polypropylene threaded plugs or bolted manways. All fittings and penetrations are polypropylene and are located according to the specification.
 3. Engineering Data: Neutralization tank to be structurally and hydraulically engineered conforming to Uniform Plumbing Code.
- D. Fill: Chemical rock of 1" to 3" diameter with calcium carbonate equivalent in excess of 85%.

2.26 LINT INTERCEPTOR - LT-1 (Central System up to 20 GPM)

- A. Manufacturers:
 - 1. Jay R. Smith 8910 Series.
 - 2. Zurn Z-1185.
 - 3. Josam 61805.
 - 4. Mifab - MI-LINT.
 - 5. Watts - LI-800
- B. Capacity: 20 GPM
- C. Construction:
 - 1. Fabricated Steel with Gray Duco Coating and Stainless-Steel Primary and Secondary Lint Screens, 3/16" Diamond Plate Cover (Secured & Gasketed) and Threaded Inlet and Outlet.
 - 2. Provide flanges, connections and extensions as required by field installation conditions
 - 1.

2.27 SAMPLING WELL

- A. Manufacturer: Manufacturer: Parks Model SWB, Old Castle, or Jensen Precast..
- B. Construction:
 - 1. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth.
 - 2. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48 Class 30. Manhole shall have 15 inch inside diameter and be traffic duty AASHTO H-20 and gas-tight access covers.

2.28 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless-steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 - 4. Manufacturers:
 - a. Febco 825Y.
 - b. Hersey FRP II
 - c. Wilkins 975.
 - d. Watts Series LF909, or approved equal
- B. Double Check Valve Assemblies:
 - 1. Comply with ASSE 1012.
 - 2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
 - 3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.

4. Manufacturers:
 - a. Febco 815.
 - b. Hersey BCP
 - c. Wilkins 760.
 - d. Watts Series 9D or approved equal.
- C. Dual Check Valves:
 1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
 2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
 3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
 4. Manufacturers:
 - a. Wilkins 740.
 - b. Watts Model SD-2/9BD, or approved equal
- D. Lead Free

2.29 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
 1. Sizes 1/2" through 2"
 2. All bronze body
 3. 0.25% maximum weighted average lead content
 4. Integral stainless-steel strainer screen
 5. Built-in bypass check valve
 6. FDA approved elastomers
 7. Renewable seat
 8. Union end connection
 9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
 10. Manufactured by Wilkins Series 600XL or approved equal by Watts
- B. Large Demand Systems
 1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
 3. Pressure reducing pilot control
 4. Stainless steel disc guide, seat and bearing cover
 5. Stainless steel stem, nut and spring
 6. FDA approved Nylon reinforced Buna-N rubber diaphragm
 7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
 8. Cla-Val Company Series 90 or approved equal by Watts

2.30 WATER HAMMER ARRESTORS

- A. Manufacturers: Watts Series LF15M2 Series or approved equal.
- B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.

- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.
- E. Lead Free.

2.31 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
 - 1. Leonard.
 - 2. Acorn controls.
 - 3. Power.
 - 4. Bradley.
 - 5. Zurn/Wilkins.
- B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.
- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- D. Capacity:
 - 1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
 - a. Model:
 - (1) Lawler 1070 Series
 - (2) Leonard - 170-LF
 - (3) Acorn controls - ST70CP-38
 - (4) Power - LFLM495
 - (5) Zurn/Wilkins - ZW3870XLT-4P
 - 2. TMV-2: 3 gpm Min. and 14 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-25
 - (2) Leonard - LV-186-982-LF-STSTL-REC.
 - (3) Acorn controls - SFMV Series
 - (4) Power - ETV200
 - (5) Bradley - TMV-25
 - 3. TMV-3: 3 gpm Min. and 30 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-80
 - (2) Leonard - LV-186-983-LF-STSTL-REC.
 - (3) Acorn controls - SFMV Series
 - (4) Power - ETV200
 - (5) Bradley - TMV-80
- E. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.
- F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.

- G. Mechanical Rooms: Omit cabinet, surface mount.
- H. Mount:
 - 1. TMV-1 in piping under lavatory/sink/etc.
 - 2. TMV-2 in wall mounted stainless steel cabinet.
 - 3. TMV-3 in wall mounted stainless steel cabinet
- I. Lead Free.

2.32 SOLENOID VALVES

- A. ASCO Series Next Generation
- B. Provide at each kitchen cooking hood and at each science lab prep room and demo table where for automatic gas supply shut-off.
- C. Coordinate electrical connections with Division 26.

2.33 INLINE AUTOMATIC WATER FILTER

- A. A 10 to 25 micron Water filter to be provided on the main cold-water line (Amiad SAF series).
- B. The SAF series are automatic filters, with a self-cleaning mechanism driven by an electric motor. The SAF filters are designed to work with various types of screens in filtration degrees from 800 to 10 micron. The ABF series is available in inlet/outlet diameters of full size as incoming water service.
- C. Controller shall be Electro-Mechanical Relay and Timer. The self-cleaning cycle begins under any one of the following conditions:
 - 1. Receiving a signal from the Pressure Differential Switch.
 - 2. Time interval parameter set at the control board.
 - 3. Manual Start.
- D. Power.
 - 1. 460/3/60
 - 2. Coordinate electrical connections with Division 26.

2.34 FLOW METER

- A. Water meter
 - 1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-4300 meter with the followings.
 - a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 1.6 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
 - f. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)

- g. Digital communications: RS-232, RS-485, Modbus RTU
 - h. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Siemens
 - c. Dynasonics
 - d. Onicon
- B. Natural gas meter
 - 1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-5500 meter with the followings.
 - a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 0.16 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Input power: 12-28 VDC, 6 W min.
 - f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
 - g. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - h. Digital communications: RS-232, RS-485, Modbus RTU
 - i. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Thermal Instrument Co.
 - c. Dynasonics
 - d. Onicon
- C. Blowdown meter
 - 1. Provide 2" stainless steel water flow meter with pulse output at the cooling tower blow down line or as indicated on plan.
 - 2. Provide PRM # WM200SSVX meter with the followings.
 - a. Accuracy +/- 5.0% of transitional flow and +/- 2.0% normal flow
 - b. Process pipe-wall temperature: 32°F to 104°F
 - c. Flow range: 2-100 GPM.
 - d. Output signals:
 - (1) Pulse (configurable)
 - e. Materials:
 - (1) 304 Stainless steel
 - (2) Seal: Viton
 - f. Standard cable length: 10 ft (9 m), Maximum cable length
 - 3. Acceptable Manufacturers:
 - a. Stenner
 - b. EKM
 - c. Carlon Meter

d. PRM

D. Warranty

1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.35 TEMPERATURE INSTRUMENTS

A. Manufacturer: Terrice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.

B. Thermometer Wells.

1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
4. Wells shall be sized to extend a minimum of 50% into pipe

2.36 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00

B. Install water heater with the followings.

1. Maintain manufacturer's recommended clearances around and over water heaters.
2. Connect natural gas piping in accordance with NFPA 54.
3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.
4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
5. Install the following piping accessories.
 - a. On supply:
 - (1) Thermometer well and thermometer.
 - (2) Strainer.
 - (3) Pressure gage.

- (4) Shutoff valve.
 - (5) Diaphragm-type expansion tank
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Pressure gage.
 - (3) Shutoff valve.
 - 6. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
 - 7. Install discharge piping from relief valves and drain valves to nearest floor drain.
 - 8. Install circulator and diaphragm expansion tank on water heater.
 - 9. Install water heater trim and accessories furnished loose for field mounting.
 - 10. Install electrical devices furnished loose for field mounting.
 - 11. Install control wiring between water heater control panel and field mounted control devices.
 - 12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
 - 13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.
- C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- 1. Install the following piping accessories.
 - a. On supply:
 - (1) Pressure gage.
 - (2) Shutoff valve.
 - (3) Check valve.

- b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Timer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
- D. Water softener: Install system components according to manufacturer's published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.
 - 1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.
 - 2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (twenty-four hour) water service is required.
 - 3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.
 - 4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.
- E. Backflow Preventers and Vacuum Breakers.
 - 1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
 - 2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.
 - 3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
 - 4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
 - 5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
 - 6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

- F. Water Hammer Arrestors (Hydraulic Shock Absorbers).
1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.
 2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
 3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.
- G. Water Pressure Regulating Valves.
1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
 2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.
 3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
 4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- H. Install diaphragm-type expansion tank on cold water supply line.
- I. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.
- J. Sewer and Sump pump Discharge Piping:
1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
 2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 - COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 - PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 SINKS

- A. Fixture Manufacturers:
 - 1. Elkay Mfg.
 - 2. Just
 - 3. American standard

4. Advance Tabco
- B. Fixture Trim Manufacturers:
 1. Chicago Faucet Co.
 2. T & S Brass
 3. Symmons
 4. Speakman
- C. Supply Fittings Manufacturers:
 1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2" x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD or provide as indicated on plumbing fixture schedule.
Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
- F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD or provide as indicated on plumbing fixture schedule.
Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard.
- G. SK-3: Double Compartment Bowl: ASME A112.19.3; 60" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Advanced Tabco Model DBS-53C or provide as indicated on plumbing fixture schedule.
 1. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet

Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.

- H. Accessories:
 - 1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 - 2. Chrome plated 17 gage brass basket strainer.
 - 3. Removable key stops.
 - 4. Flexible supplies.
 - 5. Trap and waste insulated and offset to meet ADA compliance.
- I. Provide offset waste on all sinks.

2.2 LAB SINKS (LS-1)

- A. Manufacturers:
 - 1. Kewaunee
 - 2. Fisher Hamilton Industries
 - 3. Total Lab Solutions
 - 4. Durcon
 - 5. LOC Scientific
- B. Fixture Trim Manufacturers:
 - 1. Chicago Faucet Co.
 - 2. T & S Brass
 - 3. Symmons
 - 4. Speakman
- C. Supply Fittings Manufacturers:
 - 1. Chicago.
 - 2. McGuire.
 - 3. Brasscraft.
 - 4. Zurn.
- D. Drop-in Type Sinks:
 - 1. Single Compartment Bowl: ASME A112.19.3; 17 x 20 x 5-1/2 inch outside dimensions drop-in type stainless steel or refer to Drawings. Provide minimum 18 gauge, Type 304 stainless steel with insulation undercoating. (coordinate with lab furniture for exact dimension).

- E. SK-4: Singlrt Bowl: ASME A112.19.3; 17" x 15" x 17" outside dimensions, 16 gage thick, Type 304 stainless steel. Wall mounted with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Uline Model: h-11726 or provide as indicated on plumbing fixture schedule.
- F. Provide stainless steel strainer, outlet, standpipe overflow, and stopper for all sinks unless otherwise specified.
- G. Provide tailpieces and trap compatible with waste piping systems for all sinks unless otherwise specified.
- H. Provide units that comply with SEFA 7, Laboratory Fixtures. Provide Chicago Model 930 CP -317 faucet & fittings or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- I. Provide Chicago Model 982-909CAGCP turret or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- J. Finish: Polished chrome on brass body with a clear acid and solvent-resistant epoxy coating unless specified otherwise.

- K. Equip valve handles with color coded plastic index buttons as follows:

Service	Indexing	Button Color	Lettering Color
Cold Water (Potable)	CW	Green	White
Hot Water (Potable)	HW	Red	White
Lab Air	AIR	Orange	Black
Natural Gas	GAS	Dk. Blue	White
Vacuum	VAC	Yellow	Black
Deionized Water	DI	White	Black
Carbon Dioxide	CO2	Pink	Black
Reverse Osmosis Water	RO	White	Black
Argon	AR	Violet	White
Helium	HE	Black	White
Hydrogen	H2	Pink	Black
Specialty Gas	SG	Lt. Blue	Black

Trim Manufacturers:

1. Chicago Faucets
 2. Watersaver Faucet Co., Inc.
 3. Zurn
 4. Royal Brass
- L. Preparation: Provide openings, accesses, cutouts, etc., in casework units and tops as necessary to permit installation of fittings at the Project Site.

2.3 LAVATORY and SINK INSULATION & SHIELD KIT

- A. Manufacturers:
 - 1. Truebro/IPS
 - 2. Plumberex
 - 3. Zurn
- B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.
- C. Provide Lavatory shield: Rigid enclosure is dimensionally engineered to comply with ADA requirements, design aesthetics and mechanical cooperation. LAV SHIELD conceals electronic faucet components, mixing valves, trap primers and instantaneous water heaters*, eliminating vandalism while allowing wheelchair accessibility under lavatories. Available in the standard model for field fit applications or may be ordered as a factory pre-cut which closely follows the underside contours of the lavatory specified.
 - 1. UL listing in accordance with ADA Standards.
 - 2. Flammability - UL-94 V-0, 5VA ASTM D-635-91 4 (ATB) 2.1 (AEB).

2.4 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH (EW-1)

- A. Manufacturers:
 - 1. Encon Safety Products
 - 2. Haws Drinking Faucet Co.
 - 3. Guardian Safety Equipment
 - 4. Speakman
 - 5. Or approved equal
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 ¼" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and ½" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.
- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 - 2004, and come with a full 2-year warranty.
- D. Fixture:
 - 1. (EW-1): Guardian Equipment GBF 2150SSH-PCC for all Lab Classrooms.
- E. Alarm Option:
 - 1. AP275-200 alarm unit, with light and horn. (blue color light) Light and horn shall be installed in corridor outside of science lab (120 VAC, 0.5 AMP).

- 2. Locate the blue light in the ceiling of the main corridor area directly outside room where emergency shower is installed. Provide one light per shower/valve configuration. Guardian AP280-235 (120v/1/60hz - 0.11 amp) for GBF 2150SSH-GC and Guardian AP280-230 (120v/1/60hz - 0.11 amp) for GBF 1909SSH-GC
- F. Hot water Option: TMV G3800LF Thermostatic mixing valve per ANSI Z358.1-2014.
- G. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- H. Furnish universal emergency sign.

2.5 FLOOR DRAINS

- A. Manufacturers:
 - 1. Josam Mfg.,
 - 2. Jay R. Smith Mfg.,
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. [For restroom only.](#)
- C. Floor Drain (FD-2): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable light duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415N-P (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. [For Janitor Closet and general space only.](#)
- D. Floor Drain (FD-3): ASME A112.21.1; Cast iron flanged receptor with seepage holes, acid resistant coated interior and indirect waste drain, nickel bronze rim and secured grate. Secondary strainer or sediment bucket with. Zurn ZN-1970-KC-11 (Vandal-Proof Secured Top) with 4" funnel drain for freezer drain only or provide as indicated on plumbing fixture schedule. [For Kitchen and AHU area](#)

2.6 FLOOR SINKS

- A. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries

5. Mifab
6. Watts

- B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. [For Kitchen and AHU area](#)

2.7 TRAP SEAL PRIMERS

- A. Manufacturers:
1. PPP Inc.
 2. Jay R. Smith Mfg.
 3. Siouxchief
 4. Zurn Industries
 5. Mifab
 6. Watts
 7. Sloan
- B. Trap Seal Primers-Pressure Drop Type (TP-1)
1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
 - a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.
 - b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.
- C. Trap Seal Primers-Flush Valve Type (TP-2)
1. Vacuum breaker trap primer attached to water closet flush valve, similar to Sloan VBF-72-A.
- D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.

2.8 TRAP GUARDS

- A. Provide trap guards (TG-X) inline floor drain trap sealer to be manufactured the Green Solution Sure seal Vent Guard, Model #SSX009V. (X = 2 for 2"; 3 for 3"; 4 for 4").

2.9 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers

- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- D. Floor, Outdoors: Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 - F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.
- G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.10 RECESSED VALVE BOX

- A. Manufacturers: Guy Gray, or approved equal.
- B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.
- C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.

- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 22 51 00 - LABORATORY SAFETY DEVICE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete installation for a laboratory safety device system type listed in this section for each science lab/classroom. Refer to plans for quantity of science labs/classrooms.

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of all equipment indicating components and connections to other equipment and piping. Indicate power requirements.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 WARRANTY

- A. Provide a 2 year minimum warranty from date of acceptance of project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.

1.6 SCOPE OF WORK:

- A. Each Utility Controller Where shown on the drawings and herein specified shall operate as an independent control system.
- B. Plumbing: It shall be the responsibility of the Plumbing Contractor to provide in his base bid all devices and other provisions for the Laboratory Safety Device System as outlined in the Drawings and Specifications and equipment as scheduled.

Electrical: It shall be the responsibility of the Electrical Contractor to provide in his base bid all devices, conduit systems, standard electrical boxes, operating power, all low voltage control wiring for the Laboratory Safety Device System as outlined in the Drawings and Specifications and equipment as scheduled.

1.7 CODES AND REGULATIONS

- A. NFPA 45, Fire Protection for Laboratories Using Chemicals
- B. NFPA 54, National Fuel Gas Code

- C. NFPA 70, National Electrical Code
- D. NFPA 72, National Fire Alarm Code
- E. NFPA 90A, Installation of Air Conditioning and Ventilation Systems.
- F. Americans with Disabilities Act
- G. Uniform Building Codes
- H. International Building Codes
- I. International Fuel Gas Code
- J. Local and State Building Codes
- K. All requirements of the local Authority Having Jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Lab Automation Control systems (LACS) by E & I
- B. ISIMET LLC
- C. Basic Lab Controls (BLC)

2.2 UTILITY CONTROLLER:

- A. Where shown on Drawings, provide a utility controller assembly. Assembly shall include:
 - 1. Door panel-mounted individual thumb switches to activate remote 120 VAC solenoids and relays to control the domestic water, natural gas, and electrical convenience outlets; or other indicated services or devices.
 - 2. Door-panel mounted momentary panic button assembly.
 - 3. Enabling key switch that restricts activation of output circuits to the Instructor. Deactivation of output circuits shall not require engagement of enabling key.
 - 4. Panel shall have integral printed circuit board with logic device to provide 120-vac output circuits to activate Gas and Solenoid valves, 120 VAC Electrical Outlets at Student & Teachers Work Stations. Activation of output circuits shall be enabled only by switch ON and then keying.
 - 5. Controller to be Integrated with Solenoid Valve Enclosure & Electrical Contact Enclosure and includes Red Key Operated Pushbutton On/Off Switch with Emergency Panic Control.
 - 6. Wall Box Panel (8" x 10" x 4") shall be brushed stainless steel with panel service switch. The wall box shall be surface mounted NEMA 1 rated.
- B. Utility Controller compliance:

1. UL listed components.
- C. Acceptable Controllers:
1. 1000 Series manufactured by ISIMET.
 2. BLC-08XXX-SM manufactured by BLC.
 3. LCP manufactured by LACS.

2.3 ELECTRICAL CIRCUIT ENCLOSURE:

- A. Where shown on Drawings, provide a lighting contactor enclosure with mechanically held contacts. The enclosure is a pre-assembled NEMA 1 gray power coated enclosure with hinged screwdriver latch door.
- B. The enclosure (16" x 16" x 6") is surface mounted and has relay contact blocks (120 VAC min 30 -100 amps each) to control up to 48 electrical outlets at each student and teacher work station.
- C. The enclosure shall be connected to the Utility Controller by Division 26 contractor as shown on Electrical Drawings. Enclosure location and number of contacts are as noted on Electrical Drawings and Electrical Load Control Schedule. Enclosure shall be furnished under this section and provided to the Division 26 Contractor for installation.
- D. Acceptable Contactors:
1. E-Series by ISIMET.
 2. BLC Series manufactured by BLC.
 3. ECP manufactured by LACS

2.4 REMOTE PANIC ASSEMBLY:

- A. Where shown on Drawings and where classroom size and configuration restricts maximum fifty-foot clear path range from work-areas to Utility Controller, provide a wall mounted Remote Panic Assembly. Assembly shall be located as shown on Drawings. Integrate Assembly with Controller.

2.5 SOLENOID ENCLOSURE:

- A. Where shown on Drawings, provide a 20" H x 20" W x 6" D Solenoid valve enclosure. The enclosure shall be coated with white powder NEMA-1 with full panel door, cooling fan and keyed lock.
- B. The enclosure shall house a 120 VAC normally closed gas, water solenoid valve, integrated emergency shut-off button, key reset switch, control switch for gas and water service to science prep room, fume hood, and teacher's demo desk outlets or as indicated on drawings.
- C. Provide with integral in-line filters for each domestic water service assembly. Enclosure shall be integrated with Utility Controller as shown on Drawings. Number of solenoid assemblies, intended use and pipe sizes are as noted in Equipment Schedule. Locate enclosure as shown on Drawings. Provide shock arrestor downstream at each domestic water service assembly. Provide isolation valve upstream of solenoid valve.

- D. Acceptable Contactors:
1. S-Series by ISIMET.
 2. BLC Series manufactured by BLC.
 3. VP manufactured by LACS

2.6 INTEGRATION AND CONFIGURATION:

- A. INTEGRATION WITH OTHER BUILDING SYSTEMS:
1. CAUTION — Operation of emergency devices including emergency showers and eyewashes shall not be integrated with this system for either activation or deactivation.
 2. Energy Management Control System:
 - a. Where shown on Drawings, provide low voltage integration wiring to connection point of mechanical air handling device that serves each classroom where a Utility Controller is installed. Verify available voltage as either 24 vac or 5 vdc. Make connection of wiring and configure Controller to activate with available control voltage.
 3. Building Alarm System:
 - a. Where shown on Drawings, provide low voltage integration wiring from each Utility Controller to connection point of Building Alarm System. Configure Controller to comply with Alarm System monitoring requirements. From Building Alarm System provide low voltage wiring to receive output signal from that system for shut-down of Controller in case of fire alarm. Final connection by others
- B. SYSTEM CONFIGURATION:
1. Utility Controllers shall be factory configured to the specified configurations, and shall be capable of field adjustments to meet specific project modification requirements. Configurations shall be limited to specific placement of control cabling and jumpers at PC Board without requirement for additional modifications to equipment.
 2. Classroom Utilities:
 - a. Each utility service with outlets at student work-stations shall be controlled by independent output circuit at the Utility Controller. Control of services shall not be combined onto one output circuit unless indicated on Drawings. Services shall be activated by Controller door panel switches and the engaging of the service enabling key. Activation of utility services shall be restricted to the Instructor by means of the enabling key switch. Where systems include domestic hot and cold water, then a single output circuit shall control those systems simultaneously. Where shown on drawings, compressed air system shall be controlled by an auxiliary output circuit.
 3. Energy Management Control System — “ems”
 - a. Each Utility Control System shall be configured so that all controlled utilities and devices disengage at the end of the daily occupied period. Withdrawal of the low voltage control signal from the Energy Management Control System at the room’s air handling device shall disable the Controller during the non-occupied “ems” mode. Signal shall originate from either a 5 vdc point on the PCU or from 24 vac dry contacts. Verify that Controller is field-configured to accept specified control signal. Controller shall be reactivated upon return of control

signal. Controller output circuits shall only re-activate by engaging enabling key switch. Verify voltage of control signal prior to placing the unit into service. Provide for additional monitoring output circuit at Controller for integration with "ems".

4. Building Alarm System:
 - a. Where indicated by the Drawings, configure each Utility Controller for 5 vdc alarm to integrate with the Building Alarm System. Building Alarm System shall monitor the Controller for Panic. Controller shall accept fire alarm input signal from Building Alarm system for automatic shut-down. Integration with the Building Alarm System should be configured so that any fan activated by the Panic State will deactivate upon a Fire-Alarm signal from that system.
5. Panic Reset:
 - a. Unless stated elsewhere on Drawings, the Utility Controller shall be configured so that reset of Panic State may occur at service enabling key switch on door panel. Where LX Model is specified, reset shall occur at interior reset button located on PC Board.
6. Fire Alarm Reset:
 - a. Unless stated elsewhere on Drawings, the Utility Controller shall be configured so that reset of Alarm State can occur only by manual reset at the Electrical Load Center Enclosure. Continued fire alarm signal to enclosure shall prevent reset.
7. Fume Hoods:
 - a. Where indicated by the Drawings, configure classroom fume hoods so that Utility Controller will disable the fume hood during "room non-occupied" mode. Operating power shall be routed through control relay located in ELC-Series Enclosure for the specified room. Low voltage control wiring from remote circuit #5 on Controller shall engage control relay for fume hood. Fume hood shall not be operational until after first enabling. Key engagement.
8. Instructor Demonstration Stations:
 - a. Integration with Controller shall permit shut-down of station on "ems" withdrawal and reactivation upon "ems" active only upon key engagement at LA Series Panel (where provided). Panic button at Controller or station shall disable station. Reset after panic at the station shall be.
9. Purge-Exhaust Fan:
 - a. Where indicated by the Drawings, classrooms having an exhaust fan shall have fan configured with Utility Controller so that fan will automatically purge classroom in case of emergency. Fan shall be integrated with Utility Controller at an auxiliary circuit and shall operate at full speed upon pressing of the Panic Button. Operating power for the fan shall be routed through control relay located at the ELC — Series Enclosure. Switching for the fan shall be by auxiliary circuit switch located on door panel of Controller. Provide control wiring from Controller to contacts for fan. Except for panic, exhaust fan shall not be operational at full speed until after first enabling key engagement. Field configure circuit for fan in order to enable fan activation on "Panic" during non-occupied periods. Fan is furnished and installed by others and shall be

normally operated at low and full speeds by the building automation system.

10. Panic Button Assemblies:
 - a. Each Utility Controller System shall be configured so that pressing the panic button will disable all utilities at all student work-stations and any integrated demonstration stations. Integrated Monitoring shall become active. Panic shall provide 5 vdc output alarm signal. Remote Panic Assemblies including Demonstration Station shall function like door mounted assembly.
11. Hand-Held KeyFob Panic Button:
 - a. When indicated in Equipment Schedule that Line of Sight Utility Controller is provided, keyfob Panic Button shall deactivate all output circuits while sending alarm and activating purge fan.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install in accordance with manufacturer's recommendations and instructions. Verify manufacturer's mounting heights to comply with ADA or other standards.
- B. Furnish and install all devices as shown on Drawings and as specified herein. Where device is to be installed by other trades, furnish and then turn over to appropriate trade for installation.
- C. Furnish, install and make final connections to monitoring and remote panic assembly panels as indicated on Drawings and specified herein. Furnish and install low voltage control wiring from Utility Controller to connection point of Energy Management Control System and Building Alarm, final connection by others.

3.2 CONDUIT:

- A. Provide conduits for control and integration wiring from point of connection to each device to accessible point above ceiling. Provide separate conduit for each device that is controlled and integrated with Controller if present. Conduits for arrays and panic assemblies shall be separate from line voltage, control wiring and integrated system wiring.

3.3 WIRING:

- A. Operating power: Shall be provided by Division 26.
- B. System Monitoring Arrays: Provide wiring from Utility Controller to each array. Make connections at monitoring device and terminate at output terminal on Controller's control panel if present.
- C. Remote Panic Assembly: Provide control wiring from Utility Controller to each Remote Panic Assembly Panel within the classroom (where required by Drawings). Where Drawings indicate two or more remote panels, connect each panel in parallel.

3.4 PLUMBING:

- A. Make final connections to all piping systems where indicated by Drawings and specifications. Install in accordance with SECTION 22 05 29 — Plumbing Hangers and Supports.

3.5 ELECTRICAL:

- A. Electrical Contractor shall furnish all conduit and wiring, making final wiring connections to all equipment as indicated by Drawings and specifications. Contractor shall be responsible for all system configurations, integration, test and start-up.

3.6 SYSTEM TEST AND START-UP

- A. Prior to placing the Utility Controller System into service, perform ALL Start-up procedures and Checklists as stated in Manufacturer's Operations and Maintenance Procedure literature.
- B. Verify that all components and control devices comply with manufacturer's requirements and recommendations, and that all devices and installations conform to Drawings and Specification requirements.
1. Verify that all controlled piping systems have been thoroughly cleaned.
 2. Verify that all controlled devices and circuits are ON.
 3. Verify that connections to all integrated systems are complete.
 4. Verify that all monitoring systems respond to Panic.
 5. Verify that remote panic assemblies activate the Panic State.
 6. Verify that service to emergency showers and eyewashes are not affected by operation of system.
- C. Upon completion of ALL Start-up tests, place the system into service. Complete all warranty registration documents. Submit originals with other project related closeout and O & M documentation. Review all operating procedures with a representative of the Owner. Provide all System keys (3 sets) to the Owner's representative.

3.7 EQUIPMENT SCHEDULE:

<u>F</u>	<u>Product</u>	<u>ISIMET Model #</u>	<u>Style</u>	<u>Remarks</u>
P	Utility Controller	12x9	3 Circuit W/ Auxillary Fan	24 vac Output Circuits
E	E - Series	E-318-S-L-F	8 - Circuit Mechanically	W/ Relays for Fan Circuit
	Electrical Enclosure		Held	
P	S - Series	S-1213-K-F	24 vac - 3/4"	Dom. CW - HW
	Solenoid Enclosure		3 - Station	Nat. Gas

END OF SECTION 22 51 00

SECTION 22 60 53 - LABORATORY VACUUM AND GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 22 05 00 - Plumbing General

1.3 SUMMARY

- A. This section includes the furnishing of all labor and materials necessary for complete installation, cleaning, testing and certification of gas distribution and monitoring systems, including; piping, inlets, outlets, alarms, valves, supports, labeling, identification and all related accessories. Laboratory gas systems include as followings.
 - 1. Gas-powered-tool compressed-air piping, designated "instrument air".
 - 4. vacuum piping, designated "vacuum."

1.4 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. NFPA 45 Fire Protection For Laboratories Using Chemicals
 2. NFPA 99 Standard for Health Care Facilities.
 3. NFPA 70 National Electric Code
 4. ASTM B819 Seamless Copper Tube for Medical Gas Systems.
 5. AWS A5.8 Brazing Filler Metal.
 6. CGA V-5 Diameter Index Safety System.
- D. Comply with all Federal and State regulations applicable to this installation.

1.5 QUALITY ASSURANCE

- A. All materials, equipment, installation, testing and certification shall be in strict accordance with NFPA 99 for Level 1 Medical-Surgical Vacuum, WAGD and Gases.
- B. Manufacturer's name and pressure rating shall be permanently marked on valve body.
- C. Products of same type shall be by one manufacturer. All valves, valve boxes, inlets, outlets, alarms and associated components shall be supplied by a single manufacturer and shall be fully compatible with existing system and service devices.
- D. Verify compatibility of all new components with existing system and services.
- E. Maintain one copy of each Contract Document on Site.
- F. Prior to any installation Work, the installer of laboratory vacuum and gas piping shall provide and maintain documentation on the job Site for the qualification of brazing procedures and individual brazers as required by NFPA 99.

1.6 SUBMITTALS

- A. General:
 1. All submitted data shall be specific to this project and identified as such. Generic submittal data will not be accepted.
- B. Product Data:
 1. Manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics and connection requirements.
- C. Shop Drawings:
 1. Wiring diagrams for laboratory vacuum and gas alarm systems. Differentiate between manufacturer-installed and field-installed wiring.
- D. Record Documents:
 1. Record actual locations of piping, valves, alarm sensors, alarm panels, station inlets and outlets.

2. Prepare and provide valve charts.
3. Provide record of test procedures and the results of all tests indicating room and area designations, dates of the tests, and names of persons conducting the tests.
4. Brazier Certificates: Installation Contractor shall present written documentation (less than 3 years old) from a recognized agency trained in administering and testing brazing techniques as per AWS B2.2 or ASME Section IX, certifying that all brazers have been thoroughly trained and tested in the complete installation of medical gas systems.
5. Product Certificates: The installer shall furnish documentation certifying that all installed pipe, valves, fittings, station outlets, and other piping components in laboratory gas systems shall have been cleaned for oxygen service in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service and NFPA 99. Submit letter signed by manufacturer certifying that copper tubing complies with NFPA 99. Submit letter from manufacturer stating that station outlets and inlets are designed and manufactured to comply with NFPA 99. Outlet and inlet shall bear label of approval as an assembly, by Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation.
6. Inspection and Test Reports: Furnish documentation that all installer inspections and tests required by NFPA 99 for Level 1 Medical-Surgical Vacuum, WAGD and Gases have been performed. Identify test type, procedure and results.

Independent Third Party System Verification Testing Agency Reports and Certification: Documentation verifying that completed systems have been installed, tested, purged, and analyzed in accordance with the requirements of referenced standards and contract documents. Provide copy of agency's written Q-91 standards.

Provide full written description of manufacturer's warranty.

E. Operation and Maintenance Data:

1. Operation Data: Include manufacturer's installation and operating instructions.
2. Maintenance Data: Servicing and testing requirements, inspection data, exploded assembly views, Record Documents, inspection data, test reports, installation instructions, replacement part numbers and availability, location and contact numbers of service depot.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Tubes, valves, fittings, station outlets, and other piping components in laboratory gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.
- B. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
- C. Fittings, valves, and other components shall be delivered sealed, labeled, and kept sealed until installation.

- D. Where contamination is known to have occurred, the materials affected must be removed and replaced with new materials that are cleaned and sealed by the manufacturer or supplier.

1.8 QUALIFICATIONS

- A. General: Companies specializing in manufacturing, installing, testing, certifying and servicing the products and systems specified in this Section shall have minimum five (5) years documented experience and be certified as required by the Texas Department of Health and NFPA 99.
- B. Manufacturers: Firms regularly engaged in manufacture of medical vacuum and gas systems equipment and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years. References may be required.
- C. Equipment Supplier: The laboratory vacuum and gas systems equipment supplier shall provide the services of a manufacturer authorized product specialist to periodically coordinate with the installing Contractor during initial installation of the pipeline systems and have a service organization located within 50 miles of the Project Site to provide ongoing service support to MD Anderson Cancer Center after project completion.
- D. Installer: Firm with at least five (5) years of successful installation experience on projects with medical vacuum and gas systems work similar to that required for Project. All installations of the piping systems shall be done only by, or under the direct supervision of a holder of a master plumber license or a journeyman plumber license with a medical gas piping installation endorsement issued by the Texas State Board of Plumbing Examiners. All installers of laboratory vacuum and gas system components must be qualified in accordance with the requirements of NFPA 99 and ASSE 6010, Medical Gas Systems Installers Professional Qualifications Standard. In addition, all brazers of laboratory gas system piping must be qualified in accordance with the requirements of either Section IX, Welding and Brazing Requirements of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, Standard for Brazing Procedure and Performance Qualification.
- E. System Verification Testing Agency: Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ANSI/ASSE Standard 6030, Medical Gas Verifiers Professional Qualifications Standard. Quality control standards of testing agency shall be in strict accordance with American National Standards Institute (ANSI) Q-91. Firm shall be regularly engaged in the testing and certification of similar facilities with a minimum of five (5) years of experience.
- F. Installer of axially swaged fittings shall be certified by a recognized agency trained in administering axially swaged fitting installation techniques. Installation Contractor shall present written documentation of certification (less than 3 years old).

1.9 LABORATORY GAS PIPE "HOT-TAP" PROCEDURE

- A. Connections to active laboratory gas piping may be performed only when approved in writing by and closely coordinated with the Owner.
- B. Connections shall be performed by a firm specializing in "Hot-Tapping" existing active laboratory gas piping systems.

- C. The procedure shall incorporate blocking valves, blocking glands, pneumatic end seals and employ a cryogenic compression fitting technology that is approved by The National Fire Protection Association and manufactured for use on medical gas and vacuum pipe systems.
- D. Cryogenic compression fittings shall be ASTM F 2063, nickel-titanium, shape-memory-alloy, manufactured cleaned, purged, and sealed for oxygen service according to CGA G-4.1. Memory-metal fittings shall be tested and rated to burst pressure of the copper pipe, approximately 7500 psig. The coupling shall meet or exceed the standard for a brazed joint and not generate any contamination during installation.
- E. Couplings shall be applied without the use of heat and shall provide a permanent, leak-free, metal-to-metal seal between the coupling and the tubes or pipe throughout the life of the joint.
- F. Redundant components shall be available during the procedure for re-installation purposes.
- G. Acceptable Medical Gas "Hot-Tapping" Vender:
 - 1. Smart Tap, Inc. - P.O. Box 277 - 415 Main Street - Oley, PA 19547 - Ph: 610-987-3001

1.10 SCHEDULING

- A. Schedule Work to ensure installation is complete, tested and certified prior to Substantial Completion.

PART 2 - PRODUCTS

2.0 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. System Description.
 - 1. Medical vacuum operating at [15 in. Hg] [20 in. Hg] [30 in. Hg] <Insert value>
 - 2. WAGD operating at [14 in. Hg] [15 in. Hg] <Insert value>.
 - 3. Dental vacuum operating at [10 in. Hg] [12 in. Hg] <Insert value>.
 - 4. HVE operating at [5 in. Hg] [8 in. Hg] <Insert value>.
 - 5. Medical laboratory vacuum operating at [12 in. Hg] [20 in. Hg] [24 in. Hg] <Insert value>.
 - 6. Laboratory low vacuum operating at [12 in. Hg] [20 in. Hg] <Insert value>.
 - 7. Laboratory high vacuum operating at [24 in. Hg] [29 in. Hg] <Insert value>.

2.2 PRESSURIZED LABORATORY GAS PIPING

- A. All pipe shall be Type "K", ASTM B819, hard drawn seamless copper medical gas tubing. Pipe shall be identified by the manufacturer's markings, "OXY," "MED," or "OXY/MED" and with size designated reflecting nominal inside diameter.

- B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Braze Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.
- C. Braze joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538 degrees C (1000 degrees F). Copper-to-copper joints shall be brazed using a copper-phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.
- D. Threaded joints in laboratory gas distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such as Teflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required these shall be I.P.S. brass.
- E. The use of shape memory alloy couplings may be used when making connections to existing piping sizes 2 inches and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals "CryoMed" or AeroFit "CryoFit".
- F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2" and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.
- G. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.
- H. All pipe and fittings shall be supplied cleaned and sealed for oxygen service.

2.3 LABORATORY VACUUM PIPING

- A. All vacuum piping sizes 1-1/2 inches and smaller shall be as specified for pressurized laboratory gas pipe. Vacuum pipe sizes 2 inches and larger shall be Type "K" or "L" hard-drawn seamless copper, either ASTM B 819 medical gas tube or ASTM B 88 water tube.
- B. Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Braze Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

- C. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538 degrees C (1000 degrees F). Copper-to-copper joints shall be brazed using a copper-phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.
- D. Threaded joints in laboratory vacuum distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such as Teflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required, these shall be I.P.S. brass. Close nipples shall not be installed.
- E. The use of shape memory alloy couplings may be used when making connections to existing piping sizes 2 inches and smaller. Memory-metal couplings shall have temperature and pressure ratings joints not less than that of a brazed joint. Shape memory alloy couplings shall be manufactured by TW Metals "CryoMed" or AeroFit "CryoFit".
- F. The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2" and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable. Axially swaged fittings shall be cleaned and sealed for oxygen service and manufactured by Lokring Technology LLC.
- G. Mechanically formed, drilled and extruded tee-branch connections shall not be permitted.
- H. Couplings and fittings incorporating an o-ring seal shall not be permitted.
- I. Roll-grooved joints shall not be permitted.
- J. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.

2.4 LABORATORY VACUUM AND GAS VALVES

- A. General:
 - 1. All valves for pressurized gases and valves for vacuum services 1-1/2 inches and smaller shall be supplied cleaned and sealed (bagged) for oxygen service by the manufacturer.
 - 2. Valves for vacuum service sizes 2 inches and larger will not be required to be cleaned and sealed for oxygen service.
 - 3. Provide quantity and size of valves as indicated on Contract Drawings and as required by NFPA 99.
 - 4. Laboratory vacuum and gas valves, zone valve boxes and related accessories shall be manufactured by Tri-Tech Medical, Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.
- B. Source, Main, Riser and Service Line Shut-off Valves:

1. Shut-off valves shall be full port, double seal, ball-type three piece design, designed for vacuum to 29 inches Hg and working pressures up to 600 WOG with bronze/brass body, blow-out proof stem and chrome plated brass ball and be serviceable in the line. Valve body shall have Teflon (TFE) material ball seat and stem seals. Seats/seals, lubricants and valve material shall be compatible with oxygen, nitrous oxide, compressed air, carbon dioxide, nitrogen and mixtures thereof at continuous pressure up to 600 psig and up to 100 degrees Fahrenheit.
2. Valve shall be provided with and operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position.
3. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port to facilitate installation. On outlet pipe stub provide 1/8 inch FPT tap with plug to accept gauge or nitrogen purge connection. Stub extensions shall be supplied to Site capped at both ends
4. Valve tags showing the appropriate gas services, pressure rating, etc. shall be attached to each valve.
5. Each shut-off valve shall be provided with locking kit.

C. Zone Valve and Box Assemblies:

1. Each zone valve cabinet shall be recessed type and consist of the following components: A steel valve box housing single or multiple shut-off ball valves with tube extensions, an aluminum frame, and a pull-out removable window. Boxes shall be provided to accommodate size and type of vacuum and gas valves as indicated on Contract Drawings.
2. The valve box shall be constructed of 18 gauge steel complete with a white epoxy finish and provided with (2) two galvanized steel brackets for the purpose of mounting to structural support. The assembly trim shall accommodate various finished wall thickness of up to one inch and be field adjustable. Cabinets shall be designed to permit box assemblies to be ganged together in a vertical stack.
3. The doorframe assembly shall be constructed of anodized aluminum mounted to the back box assembly by screws as provided and shall have a sliding removable front consisting of an opaque door with a pre-mounted pullout ring and clear gauge window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe. The window shall be capable of re-installation without the use of tools and only after the valve handles have been returned to the open position. The window shall be labeled "Caution - Laboratory Gas Shut-Off Valve - Close Only in Emergency", or equivalent wording in accordance with NFPA 99.
4. Valves shall be same as specified herein for line shut-off valves except locking devices are not required.
5. Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.

6. All valves shall be securely attached to the box and provided with Type "K" washed and degreased copper pipe stub extensions of sufficient length to protrude beyond the sides of the box for connection to system piping. All pipe stub extensions shall be supplied with 1/8 inch NPT gauge port located on the terminal outlet side of the valve to register pipeline pressure or vacuum. Suitable plugs or caps shall be installed by the manufacturer to prevent contamination of the assembly prior to installation.
7. Gauges shall be minimum 1-1/2 inch diameter, with metal case and ring, and an 1/8 inch NPT brass stud at the back of the gauge for the purpose of mounting onto pipe stub extension within the box. The pipe stub extension shall be complete with a soldered gauge holder. Gauge holders shall be sealed with a brass plug to prevent contamination prior to mounting gauges. Pressure gauges shall read 0-700 kPa (0-100 psig) for all gases except nitrogen, which shall read 0-2000 kPa (0-300 psig), and vacuum, which shall read -100-0 kPa (0-30 inches Hg). Gauges shall be visible through the door of the zone valve box.
8. Valve box may house one to six valves.
9. Each valve may incorporate a gas specific DISS demand check valve for installation of a DISS specific sensor.

2.5 SERVICE INLETS AND OUTLETS

A. General:

1. Inlets and outlets shall be UL listed and conform to applicable NFPA and CGA standards.
2. Inlets and outlets shall consist of separate roughing-in and finish assemblies and be modular in design for wall recessed type installation and attachment to concealed piping.
3. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valve. The secondary check valve shall be rated at a minimum 1379 KPa (200 psi) in the event the primary check valve is removed for maintenance.
4. The roughing-in assembly shall be corrosion resistant with a permanent pin-keying system for each specific gas and be provided with a Type "K", 1/2 inch outside diameter, 6-1/2 inch long copper inlet pipe stub, which is silver brazed to the outlet body. The copper tubing inlet shall rotate 360 degrees to allow connection from any direction. The assembly shall allow pressure testing without additional labor to remove plug or adapter after testing.
5. The finishing assembly shall contain a primary check valve, pin-key indexing, a minimum of 2.5 square inches of color coding and incorporate a plaster adjustment from 3/8 inch to 3/4 inch variation in wall thickness. Design shall be such as to ensure absolutely no gas flow until the correct adapter is fully engaged. Each assembly shall have a separate cover plate for ease of service without preventing use of other inlets or outlets.

6. All inlets and outlets shall be factory assembled, tested, cleaned for oxygen service, and supplied with temporary protective covers and packages to protect outlet during handling and installation at the jobsite.
 7. Inlets and outlets and related accessories shall be manufactured by Tri-Tech Medical, Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.
- B. Wall Inlets:
1. Wall inlets for Vacuum services shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.
 2. Each vacuum outlet shall have an adjacent slide for supporting vacuum bottle assembly.
- C. Wall Outlets:
1. Wall outlets for oxygen, nitrogen, carbon dioxide and laboratory compressed air service shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapters.
- D. Casework Inlets and Outlets:
1. Laboratory casework fittings will be furnished to the jobsite by the laboratory equipment supplier, with necessary holes cut in the laboratory equipment. This Contractor shall receive, store and install the fittings and make all necessary connections thereto in accordance with manufacturer's published instructions.

2.6 LABORATORY VACUUM AND GAS ALARMS

- A. General:
1. Provide master alarms for source equipment as indicated on Contract Drawings and as required by NFPA 99.
 2. Provide area alarms for station inlets and outlets as indicated on Contract Drawings and as required by NFPA 99.
 3. Alarms shall provide signals as required by the latest edition of NFPA 99. Alarms shall be listed to UL 1069 and CSA C22.2 NO 601.1-M90 and comply with the following electromagnetic compatibility standards: FCC Part 15 Class A, ICES 003 Class A, EN 61326, EN 61000-3-2 and EN 61000-3-3. All field wiring and signals shall be self-monitoring and on a closed circuit. Fault signals shall activate on an open circuit.
 4. Input power to the alarm panel shall be 100 to 250 VAC 50/60 Hz, double fused on the input side. An internal power supply shall convert the input voltage to low voltage +5 and +24 VDC. All user accessible electronics and wiring shall utilize low voltage. A guard must be removed to access the high voltage wiring.
 5. A green front panel POWER ON indicator shall illuminate when the alarm panel is powered. Each monitored condition shall have a separate red indicator illuminated when in alarm. A red indicator on the alarm silence button shall be illuminated after any audible alarm has been silenced.

6. Each panel shall provide an audible signal activated by digital display modules or multi-signal alarm modules. The audible signal shall produce a minimum sound pressure level of 90 dBA measured at a distance of 3 feet. The alarm panel shall contain alarm silence, test, and setup buttons.
7. Each panel shall include a general fault relay for the entire panel, an RS-485 data port and an additional auxiliary relay.

Laboratory vacuum and gas alarm panels, sensors and related accessories shall be manufactured by Tri-Tech Medical, Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.

B. Area Alarms

1. Area alarm panels shall be provided to monitor laboratory gas and vacuum systems supplying animal procedure rooms, and other critical areas where indicated on Contract Drawings.
2. Digital display modules shall provide a digital LED display continuously indicating the pressure or vacuum in the piping system being monitored. The brightness of the LED display shall be adjustable to compensate for ambient lighting. The display shall be programmable to read psig, in Hg, mm Hg, or kPa in increments of 1 psig, 1 in Hg, 1 mm Hg, or 1 kPa respectively.
3. The digital display module shall provide an audible and visual signal when a fault condition occurs. A front panel alarm mute button shall be provided to silence the audio. A visual signal shall flash until the alarm silence button is pressed, and shall then remain statically illuminated. The visual signal shall automatically cancel when the fault is corrected.
4. Separate visual signals for system pressure or vacuum are NORMAL (green LED), LOW (red LED), and HIGH (red LED). Signal limits are factory set per NFPA 99 and field programmable without the use of tools. Pressing and holding the front panel TEST button initiates a self-test function to test the LED display, visual indicators, audible alarm, and to view the alarm set points.
5. Each digital display module shall be equipped with separate relays for high and low alarms. Relays shall be single-pole double-throw type (30 VAC/VDC 2A max). Digital readings from one display module shall be capable of being monitored by another digital display module at a remote panel.
6. A sensor module shall be provided for each digital display module. Sensor modules shall contain a transducer capable of providing calibrated signals to the digital display module. Sensor modules shall be gas specific. The alarm panel shall be factory configured for sensor mounting within the alarm panel rough-in box (local sensors) or directly to the pipeline (remote sensors). Remote sensors may be located within zone valve box or readily accessible above ceiling.
7. Pipeline connections shall be 3/8 inch nominal (1/2 inch OD) Type "K" copper tube. Connectors shall be provided for attaching field wiring. Sensors shall be gas specific for periodic testing without interrupting gas pipeline pressures or vacuum.

C. Master Alarms

1. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source, and the pressure in the main lines of each laboratory vacuum and gas piping system. The master alarm system shall consist of two or more alarm panels located in at least two (2) separate locations as required by NFPA 99.
2. Each Multi-signal alarm module shall be capable of monitoring up to a minimum of five (5) dry-contact signals. Each signal shall illuminate a green LED to indicating normal conditions. When a fault occurs, the green LED shall turn off, a red LED shall illuminate, and an audible alarm shall sound. The red LED shall flash until the front panel alarm silence button is pressed. After the alarm silence button is pressed, the red LED shall remain statically illuminated. The red indicator shall automatically turn off and the green LED shall illuminate when the fault is corrected.
3. LED illumination for unused signals shall be deactivated in the field. Field programming shall be accomplished without the use of tools. Pressing and holding the front panel TEST button shall initiate a self-test function to test the LED indicators and audible alarm. The multi-signal module shall be supplied with five, dry-contact, normally closed relays for connection to a building automation system. Relay ratings shall be 30 VAC/VDC 2A max.
4. A blank overlay shall be used to fill unused alarm panel locations and/or reserve a module location for future expansion. It shall be removable for installing additional modules.

D. Vacuum and Pressure Switches

1. Switches shall incorporate UL listed single-pole, double-throw, and snap-action switching elements. Switch shall automatically reset.
2. Signal setting for low vacuum shall be at 12 inches HG.
3. Signal settings for all pressure gases except Nitrogen shall be; Low - 40 psig, High - 60 psig.
4. Signal settings for Nitrogen gas shall be; Low - 140 psig, High - 190 psig.

E. Pressure switches shall be cleaned and sealed for oxygen service.

2.7 LINE GAUGES

A. General:

1. Gauges shall comply with ANSI/ASME B-40.1 and be constructed of materials compatible with medical vacuum and gas applications.
2. Gauge housings shall be drawn steel with black, corrosion-resistant paint. Dial shall be 4-1/2 inch in diameter with white background and black markings. Pointer shall be aluminum with black finish. Gauge movement shall be brass construction. Bottom of gauge shall be provided with 1/4 inch - 18 NPT - 2A brass connection.
3. Provide Diameter Index Safety System connection kits with all appropriate fittings for connecting gauges to pipelines.

4. Laboratory vacuum and gas line gauges and DISS connection kits shall be manufactured by Tri-Tech Medical, Patton's Medical/Amico, BeaconMedaes, or Owner approved equal.
- B. Vacuum Line Gauges
1. Vacuum bourbon tube shall be beryllium copper and soft soldered.
 2. Gauge shall register 0 - 30 inches HG.
- C. Pressure Line Gauges
1. Pressure bourbon tube shall be phosphor bronze and soft soldered.
 2. Gauge shall register 0 - 100 psig for all laboratory gases except Nitrogen.
 3. Gauge shall register 0 - 300 psig for Nitrogen gas.
 4. Gauges for positive pressure gases shall be cleaned and sealed for oxygen service.

2.8 UNDERGROUND WARNING TAPE)

- A. Minimum 3 inch wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.
1. Lamination bond of one (1) layer of Minimum 0.35 mils thick aluminum foil between two (2) layers of minimum 4.3 mils thick inert plastic film.
 2. Minimum tensile strength: 63 LBS per 3 IN width.
 3. Minimum elongation: 500 percent.
 4. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe by specific name buried below (e.g.: "CAUTION OXYGEN LINE BURIED BELOW").
 5. Manufactured by Reef Industries "Terra Tape" or approved equal.

PART 3 - EXECUTION

3.0 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

- C. Exercise great care in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease or any contaminants from being introduced into tubing. The interior surfaces of tube ends, fittings, and other components that were cleaned for oxygen service by the manufacturer, but become contaminated prior to being installed, shall be recleaned on-Site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water-alkaline solution, such as sodium carbonate or trisodium phosphate 450 g to 11 L (1 lb to 3 gal) of potable water and thoroughly rinsing them with clean, hot potable water. Material that has become contaminated internally and is not clean for oxygen service shall not be installed.
- D. The exterior surface of all tubes, joints and fittings shall be cleaned prior to brazing with non-abrasive pads by washing with hot water after assembly to remove any surface oxides or excess flux and provide for clear visual inspection of brazed connections. A visual inspection of each brazed joint shall be made to assure that the alloy has flowed completely around the joint at the tube-fitting interface. Where flux has been used, assure that solidified flux residue has not formed a temporary seal that could hold test pressure.
- E. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside of completed joints. (NOTE: Ensure proper ventilation. Some BAg series filler metals contain cadmium, which, when heated during brazing, can produce toxic fumes.)
- F. Joints shall be brazed within one (1) hour after the surfaces are cleaned for brazing.
- G. While being brazed, all vacuum and oxygen piping joints shall be continuously purged with oil-free, dry Nitrogen to prevent the formation of copper oxide on the inside surfaces of the joint. The purge shall be maintained until the joint is cool to the touch. The final connection of new piping to an existing, in-use pipeline shall be permitted to be made without the use of a nitrogen purge.
- H. Bury all underground piping at least three (3) feet below finished grade and fully encase within schedule 40 PVC piping sleeve. Provide a continuous detectable warning tape immediately above buried lines. Warning tape shall clearly identify the pipeline by specific name. A continuous warning means shall also be provided on tamped backfill above the pipeline at approximately one-half the depth of bury.
- I. Do not install piping in the same trench with other buried utilities. The minimum horizontal clearance between laboratory pipe and parallel buried utility pipe shall be eight (8) feet. Do not install pipe through catch basins, vaults, manholes or similar underground structures.
- J. Piping shall not be installed in kitchens, electrical switchgear rooms, elevator shafts, and areas with open flames.
- K. Memory-metal couplings shall not be installed within eight inches of a brazed joint.
- L. Shut-off valves installed for future connections shall be provided with downstream piping closed with a brazed cap and sufficient tubing allowance for cutting and re-brazing.
- M. Branch takeoffs from horizontal piping shall be taken off above the centerline of the main or branch pipe and rise vertically or at an angle of not less than 45 degrees from vertical.
- N. Support all piping in accordance with NFPA 99 and Contract Documents.
- O. Pressure and vacuum indicators shall be readable from a standing position.

- P. All alarm sensors shall be installed at readily accessible locations and shall not be obstructed by other building components.
- Q. Zone valve boxes shall be installed where they are visible and accessible at all time and readily operable from a standing position in the corridor on the same floor they serve.
- R. Area alarm panels shall be located where indicated on Contract Drawings at a nurse's station or other location that will provide for continuous responsible surveillance.
- S. Locate master alarm panels where indicated on Contract Drawings in at least two (2) separate locations as required by NFPA 99.
- T. All alarm panels shall be mounted at a height allowing monitoring and operation from a standing position.

3.2 LABELING

- A. Label all piping, valves, station inlets and outlets, and alarms in accordance with NFPA 99 requirements and Contract Documents.
- B. Re-label existing shut-off valves and alarm panels when modifications are made changing the areas served. New labels shall be in accordance with NFPA 99 and Contract Documents.

3.3 TESTING AND INSPECTION

- A. Inspection and testing shall be performed on all new piped gas systems, additions, renovations, temporary installations, or repaired systems, to assure the facility, by a documented procedure, that all applicable provisions of NFPA 99 have been adhered to and system integrity has been achieved or maintained.
- B. After brazing, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and permit clear visual inspection of the joint. Each brazed joint shall be visually inspected after cleaning the outside surfaces. Brazed joints identified as defective shall be repaired or replaced as required by NFPA 99.
- C. After installation of the distribution piping and before installation of station outlets/inlets and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators), piping in laboratory vacuum and gas distribution systems shall be blown clear by means of oil-free, dry Nitrogen.
- D. Installer shall perform initial pressure tests, cross-connection test, piping purge test and standing pressure test prior to third party system verification and in strict accordance with NFPA 99.
- E. System verification tests shall be performed only after all installer performed tests, have been completed. Equipment Vendor or installing Contractor shall not perform system verification, final testing or certification.
- F. A Third Party Medical Gas System Verification Testing Agency shall perform standing pressure test, cross-connection test, valve test, alarm test, piping purge test, piping particulate test, piping purity test, final tie-in test, operational pressure test and gas concentration test.

- G. The Third Party Medical Gas System Verification Testing Agency shall verify the presence and correctness of labeling required by this standard for all components (e.g., station outlets/inlets, shutoff valves, and alarm panels).
- H. It shall be the responsibility of the Third Party Medical Gas System Verification Testing Agency to make periodic jobsite visits to assure all requirements of this specification and NFPA 99 are strictly adhered to.
- I. Certification shall clearly state that the system is approved for use and meets all requirements of NFPA-99 inclusive of all referenced and/or related documents. Any exceptions or limitations shall be clearly stated on the same certification document.

3.4 VENDOR SUPERVISION AND OPERATING INSTRUCTIONS

- A. An authorized representative of the equipment manufacturer shall periodically check with the installing Contractor during initial installation of the pipeline systems and equipment and shall assist the Contractor in final check to make certain that all systems are operating as recommended by the manufacturer, as specified and in accordance with NFPA 99. The equipment manufacturer's representative shall provide a minimum of 4 hours instruction to MD Anderson Cancer Center personnel in the use of the piping systems and the related equipment operated from those systems.

END OF SECTION 22 60 53

SECTION 22 61 13 - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Gas-powered-tool compressed-air piping, designated "instrument air."
- B. Compressed-air piping and specialties for nonmedical laboratory facilities, designated "laboratory air."

1.3 DEFINITIONS

- A. Medical compressed-air piping systems include medical air, dental air, instrument air, and medical laboratory air.
- B. Nonmedical compressed-air piping systems include laboratory air piping systems.

1.4 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Instrument air operating at 175 psig (1200 kPa).
- B. Laboratory air operating at 50 psig (345 kPa) [100 psig (690 kPa)] [125 psig (860 kPa)].

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Medical compressed-air manifolds shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the manifold will remain in place without separation of any parts when subjected to the seismic forces and the manifold will be fully operational after the seismic event."
- C. For life safety components required to function after an earthquake (such as fire sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical air piping materials.
- B. Comply with ASME B31.1, "Power Piping," for laboratory air piping operating at more than 150 psig (1035 kPa).
- C. Comply with ASME B31.9, "Building Services Piping," for laboratory air piping operating at 150 psig (1035 kPa) or less.
- D. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.
- E. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- F. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- G. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
- H. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
- I. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- J. Shape-Memory-Metal Couplings:
 - 1. Manufacturers:
 - a. Aerofit, Inc.
 - b. Smart Tap, Inc.
 - c. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
- K. Flexible Pipe Connectors:

1. Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Gasket & Shim, Inc.
 - e. Metraflex Company (The).
 - f. Proco Products, Inc.
 - g. Unaflex.
 - h. Gast Manufacturing Inc.
 - i. General Air Products, Inc.
 - j. Viking Corporation
 - k. Universal Metal Hose; a Hyspan Co.
 - l. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - m. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - n. End Connections: Plain-end copper tube.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.

2.5 VALVES

- A. Copper-alloy ball valves with copper-tube extensions, for use with copper medical gas tube, are available in NPS 4 (DN 100) and smaller. Wrought-copper reducer fittings are used with valves when NPS 5 (DN 125) or larger medical gas tube is required.
- B. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- C. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
- D. Zone-Valve Boxes:
 1. Manufacturers:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. Ohio Medical Corporation.
- E. Ball Valves:
 1. Manufacturers:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Conbraco Industries, Inc.
 - e. Marwin Valve; a division of Richards Industries.
 - f. NIBCO INC.
 - g. Ohio Medical Corporation.
 - h. Tri-Tech Medical Inc.
 - i. AFAC inc.
 - j. Reliable Automatic Sprinkler Co. Inc.
 - k. Tyco Fire & Building Products LP
 2. Standard: MSS SP-110.

3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig (2070 kPa) minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Retain locking-type handle in "Handle" Subparagraph below if required.
8. Handle: Lever type with locking device.
9. Stem: Blowout proof with PTFE or TFE seal.
10. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

F. Check Valves:

1. Manufacturers:
 - a. Allied Healthcare Products Inc.; Chemetron Division.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Conbraco Industries, Inc.
 - e. Ohio Medical Corporation.
 - f. Tri-Tech Medical Inc.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

G. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

H. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for [250-psig (1725-kPa)] <Insert value> minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

2.6 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

- A. Manufacturers:
 - 1. Allied Healthcare Products Inc.; Chemetron Division.
 - 2. Amico Corporation.
 - 3. BeaconMedaes.
 - 4. Ohio Medical Corporation.
 - 5. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
 - 6. Tri-Tech Medical Inc.
- B. General Requirements for Medical Compressed-Air Service Connections:
 - 1. Suitable for specific medical air pressure and service listed.
 - 2. Include roughing-in assemblies, finishing assemblies, and cover plates.
 - 3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
 - 4. Recessed-type units made for concealed piping unless otherwise indicated.
- C. Roughing-in Assembly:
 - 1. Steel outlet box for recessed mounting and concealed piping.
 - 2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
 - 3. Double seals that will prevent air leakage.
 - 4. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
- D. Finishing Assembly:
 - 1. Brass housing with primary check valve.
 - 2. Double seals that will prevent air leakage.
 - 3. Cover plate with gas-service label.
 - 4. Wall service connections are typically quick-coupler type for new projects. Match existing outlet type if required.
- E. Quick-Coupler Pressure Service Connections:
 - 1. Outlets for medical air and instrument air with non-interchangeable keyed indexing to prevent interchange between services.
 - 2. Constructed to permit one-handed connection and removal of equipment.
 - 3. With positive-locking ring that retains equipment stem in valve during use.

4. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 5. Medical Air: D.I.S.S. No. 1160.
 6. Instrument Air: D.I.S.S. No. 1160.
- F. Cover Plates:
1. One piece.
 2. Stainless steel.
 3. Permanent, color-coded, identifying label matching corresponding service.

2.7 MEDICAL COMPRESSED-AIR PRESSURE CONTROL PANELS

- A. Manufacturers:
1. Allied Healthcare Products Inc.; Chemetron Division.
 2. Amico Corporation.
 3. BeaconMedaes.
- B. Description:
1. Steel box and support brackets for recessed roughing-in with stainless-steel or anodized-aluminum cover plate with printed operating instructions.
 2. Manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
 3. Minimum Working Pressure: [200 psig (1380 kPa).
 4. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
 5. Pressure Gages: 0 to 300 psig (0 to 2070 kPa).
 6. Service Connection: CGA V-5, D.I.S.S. No. 1160, instrument air outlet.
 7. Before final assembly, provide temporary dust shield and U-tube for testing.
 8. Label cover plate "Air Pressure Control."

2.8 MEDICAL COMPRESSED-AIR MANIFOLDS

- A. Manufacturers:
1. Allied Healthcare Products Inc.; Chemetron Division.
 2. Amico Corporation.
 3. BeaconMedaes.
 4. Ohio Medical Corporation.

5. Tri-Tech Medical Inc.
- B. Comply with NFPA 99, Chapter "Manifolds for Gas Cylinders without Reserve Supply."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Central Control-Panel Unit:
- E. Weatherproof cabinet.
- F. Supply and delivery pressure gages.
- G. Electrical alarm-system connections and transformer.
- H. Indicator lights or devices.
- I. Manifold connection.
- J. Pressure changeover switch.
- K. Line-pressure regulator.
- L. Shutoff valves.
- M. Safety valve.
- N. Manifold and Headers:
1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
 2. Designed for 2000-psig (13.8-MPa) minimum inlet pressure.
 3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
 4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
 5. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
 6. Mounting: Wall with mounting brackets for manifold control cabinet and headers.
 7. Use label in first paragraph below with nonstandard system pressures. Label can also indicate special service requirements.
8. Label manifold control unit with permanent label identifying compressed air and system operating pressure.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
- B. Revise procedures in subparagraphs below if required by authorities having jurisdiction.
- C. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
- D. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
- E. Scrub to ensure complete cleaning.
- F. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- C. Comply with NFPA 99 for installation of compressed-air piping.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install compressed-air piping with 1 percent slope downward in direction of flow.
- I. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

- J. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and for branch connections.
- P. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.
- Q. Retain "Piping Restraint Installation" Paragraph below if piping is required to withstand seismic design loads.
- R. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- S. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- T. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
- U. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on compressed-air piping where reduced pressure is required.
- F. Install flexible pipe connectors in discharge piping [and in inlet air piping from remote air-inlet filter] of each air compressor.

3.4 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
- D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

- A. Install compressed-air pressure control panel in walls. Attach to substrate.
- B. Install compressed-air manifolds [on concrete base] anchored to substrate.
- C. Retain first paragraph below if Contractor provides compressed-air cylinders.
- D. Install compressed-air cylinders and connect to manifold piping.
- E. Indicate seismic restraints on Drawings if required, or delete first paragraph below.
- F. Install compressed-air manifolds with seismic restraints as indicated.
- G. Install compressed-air-cylinder wall storage racks attached to substrate.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- G. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.
- H. Maximum spans in remainder of this article were taken from MSS SP-69 for copper tube and vapor service. Horizontal spacing also matches NFPA 99 for medical gas tubing.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
 13. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
 14. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
 15. Install supports for vertical copper tubing every 10 feet (3 m).

3.7 IDENTIFICATION

- A. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties.

- B. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
- C. Instrument Air: White letters on red background.
- D. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.8 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

- A. If retaining second option in "Testing Agency" Paragraph below, retain "Field quality-control reports" Paragraph in "Informational Submittals" Article.
- B. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and to prepare test and inspection reports.
- C. Tests and Inspections:
- D. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of [medical gas piping] [and] [medical vacuum piping] systems.
- E. Tests in "Preparation" Subparagraph below are required by Installer before verification by testing agency.
- F. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - 1. Initial blowdown.
 - 2. Initial pressure test.
 - 3. Cross-connection test.
 - 4. Piping purge test.
 - 5. Standing pressure test for positive-pressure medical compressed-air piping.
 - 6. Repair leaks and retest until no leaks exist.
 - 7. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - 8. Standing pressure test.
 - 9. Valve test.
 - 10. Master and area alarm tests.
 - 11. Piping purge test.
 - 12. Piping particulate test.

- 13. Piping purity test.
- 14. Final tie-in test.
- 15. Operational pressure test.
- 16. Medical air purity test.
- G. Verify correct labeling of equipment and components.
- H. Revise "Testing Certification" Subparagraph below for exact testing certification required.
- I. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
- J. Inspections performed.
- K. Procedures, materials, and gases used.
- L. Test methods used.
- M. Results of tests.
- N. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.9 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN NONMEDICAL LABORATORY FACILITIES

- A. Tests and Inspections:
 - 1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air piping with oil-free dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect [filters] [and] [pressure regulators] for proper operation.
 - 4. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.10 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.11 PIPING SCHEDULE

- A. Retain and revise piping applications in this article to suit Project. Coordinate with materials specified.
- B. Connect new tubing to existing tubing with memory-metal couplings.
- C. Flanges may be used where connection to flanged equipment is required.
- D. Piping in first paragraph below includes medical air, dental air, instrument air, and medical laboratory air piping.
- E. Medical Air Piping except Instrument Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- F. Instrument Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type K, copper tube; wrought-copper fittings; and brazed joints.
- G. Laboratory air in two paragraphs below is for nonmedical laboratory facilities in this Section.
- H. Laboratory Air Piping except Laboratory Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- I. Laboratory Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.12 VALVE SCHEDULE

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 22 61 13

SECTION 22 62 13 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. laboratory vacuum piping, designated "laboratory vacuum."
 - 2. Laboratory low-vacuum piping, designated "laboratory low vacuum."
 - 3. Laboratory high-vacuum piping, designated "laboratory high vacuum."

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Medical laboratory vacuum operating at [12 in. Hg (305 mm Hg)] [20 in. Hg (510 mm Hg)] [24 in. Hg (610 mm Hg)] <Insert value>.
- B. Laboratory low vacuum operating at [12 in. Hg (305 mm Hg)] [20 in. Hg (510 mm Hg)] <Insert value>.
- C. Laboratory high vacuum operating at [24 in. Hg (610 mm Hg)] [29 in. Hg (735 mm Hg)] <Insert value>.

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Copper Water Tube: ASTM B 88, Type M (ASTM B 88M, Type C), seamless, drawn temper [that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service].
- D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.
- E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
- G. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
- H. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- I. Use of couplings in "Shape-Memory-Metal Couplings" Paragraph below permits joining new piping to existing piping without requiring recertification of the whole piping system.
- J. Shape-Memory-Metal Couplings:
 - 1. Manufacturers:
 - a. [Aerofit, Inc.](#)
 - b. [Smart Tap, Inc.](#)
 - 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
- K. Pressure-Seal Fittings:
 - 1. Manufacturers:
 - a. Viega LLC.
 - 2. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 3. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- L. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.
 - 1. Manufacturers
 - a. [T-DRILL Industries Inc.](#)
- M. Flexible Pipe Connectors:
 - 1. Manufacturers:

- a. [Flex-Hose Co., Inc.](#)
 - b. [Flexicraft Industries.](#)
 - c. [Hyspan Precision Products, Inc.](#)
 - d. [Mercer Gasket & Shim, Inc.](#)
 - e. [Metraflex Company \(The\).](#)
 - f. [Proco Products, Inc.](#)
 - g. [Unaflex.](#)
 - h. [Universal Metal Hose; a Hyspan Co.](#)
2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 3. Working-Pressure Rating: [200 psig (1380 kPa)] [250 psig (1725 kPa)] minimum.
 4. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- C. Threaded-Joint Tape: PTFE.
- D. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.
- E. Retain first two subparagraphs below if required for LEED-NC, LEED-CI, or LEED-CS Credit IEQ 4.1.
- F. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Retain subparagraph below if required for LEED for Schools Credit IEQ 4.
- I. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 VALVES

- A. Copper-alloy ball valves with copper-tube extensions, for use with copper medical gas tube, are available in NPS 4 (DN 100) and smaller. Wrought-copper reducer fittings are used with valves when NPS 5 (DN 125) or larger medical gas tube is required.
- B. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- C. Exception: Factory cleaning and bagging are not required for valves for WAGD service.

- D. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
 - 1. Zone-Valve Boxes:
 - a. Manufacturers:
 - 1) [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - 2) [Amico Corporation.](#)
 - 3) [Ohio Medical Corporation.](#)
- E. Cover Plate: Stainless-steel with frangible or removable windows.
- F. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- G. Copper-Alloy Ball Valves:
 - 1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Conbraco Industries, Inc.](#)
 - e. [Marwin Valve; a division of Richards Industries.](#)
 - f. [NIBCO INC.](#)
 - g. [Ohio Medical Corporation.](#)
 - h. [Tri-Tech Medical Inc.](#)
 - 2. Standard: MSS SP-110.
 - 3. Description: Three-piece body, brass or bronze.
 - 4. Pressure Rating: 300 psig (2070 kPa) minimum.
 - 5. Ball: Full-port, chrome-plated brass.
 - 6. Seats: PTFE or TFE.
 - 7. Retain locking-type handle in "Handle" Subparagraph below if required.
 - 8. Handle: Lever type with locking device.
 - 9. Stem: Blowout proof with PTFE or TFE seal.
 - 10. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.
- H. Check Valves:
 - 1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Conbraco Industries, Inc.](#)
 - e. [Ohio Medical Corporation.](#)
 - f. [Tri-Tech Medical Inc.](#)
 - 2. Description: In-line pattern, bronze.
 - 3. Pressure Rating: 300 psig (2070 kPa) minimum.

4. Operation: Spring loaded.
 5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
- I. PVC Ball Valves:
1. Manufacturers:
 - a. [American Valve, Inc.](#)
 - b. [Asahi/America.](#)
 - c. [Colonial Valve; a division of Colonial Engineering, Inc.](#)
 - d. [Georg Fischer LLC.](#)
 - e. [Hayward Flow Control Systems.](#)
 - f. [IPEX USA LLC.](#)
 - g. [Jomar International Ltd.](#)
 - h. [NIBCO INC.](#)
 - i. [Plast-O-Matic Valves, Inc.](#)
 - j. [Spears Manufacturing Company.](#)
 - k. [Thermoplastic Valves Inc.](#)
 2. Standard: MSS SP-122.
 3. Description: With union ends and [150-psig (1035-kPa)] <Insert value> minimum working-pressure rating and suitable for vacuum service.
- J. PVC Butterfly Valves:
1. Manufacturers:
 - a. [American Valve, Inc.](#)
 - b. [Asahi/America.](#)
 - c. [Colonial Valve; a division of Colonial Engineering, Inc.](#)
 - d. [Georg Fischer LLC.](#)
 - e. [Hayward Flow Control Systems.](#)
 - f. [IPEX USA LLC.](#)
 - g. [NIBCO INC.](#)
 - h. [Spears Manufacturing Company.](#)
 - i. [Thermoplastic Valves Inc.](#)
 2. Description: Lug type with lever handle and [150-psig (1035-kPa)] <Insert value> minimum working-pressure rating and suitable for vacuum service.
 3. Check valves in "PVC Check Valves" Paragraph below typically have a lower pressure rating than PVC ball and butterfly valves above. PVC check valves NPS 2 (DN 50) and smaller typically are rated at 150 psig (1035 kPa), but pressure ratings decrease with increase in size. All check valve pressure ratings should be suitable for this service.
- K. PVC Check Valves:
1. Manufacturers:
 - a. [American Valve, Inc.](#)
 - b. [Asahi/America.](#)
 - c. [Colonial Valve; a division of Colonial Engineering, Inc.](#)
 - d. [Georg Fischer LLC.](#)
 - e. [NIBCO INC.](#)
 - f. [Spears Manufacturing Company.](#)
 - g. [Thermoplastic Valves Inc.](#)

2. Description: Ball-, in-line-, piston-, or swing-check design with flanged or union ends and [70-psig (480-kPa)] [100-psig (690-kPa)] <Insert value> minimum working-pressure rating and suitable for vacuum service.

2.5 MEDICAL VACUUM SERVICE CONNECTIONS

- A. Manufacturers:
 1. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 2. [Amico Corporation.](#)
 3. [BeaconMedaes.](#)
 4. [Ohio Medical Corporation.](#)
 5. [Oxequip Health Industries; a division of Allied Healthcare Products Inc.](#)
 6. [Tri-Tech Medical Inc.](#)
- B. General Requirements for Medical Vacuum Service Connections:
 1. Suitable for specific medical vacuum service listed.
 2. Include roughing-in assemblies, finishing assemblies, and cover plates.
 3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
 4. Recessed-type units made for concealed piping unless otherwise indicated.
 5. Roughing-in Assembly:
 6. Steel outlet box for recessed mounting and concealed piping.
 7. Brass-body inlet block.
 8. Seals that will prevent vacuum leakage.
 9. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
 10. Finishing Assembly:
 11. Brass housing with primary check valve.
 12. Seals that will prevent vacuum leakage.
 13. Cover plate with gas-service label.
 14. Wall service connections are typically quick-coupler type for new projects. Match existing outlet type if required.
 15. Quick-Coupler Suction Service Connections:
 16. Inlets for [medical vacuum] [and] [WAGD] with non-interchangeable keyed indexing to prevent interchange between services.

17. Constructed to permit one-handed connection and removal of equipment.
 18. With positive-locking ring that retains equipment stem in valve during use.
 19. D.I.S.S. Suction Service Connections:
 20. Inlets complying with CGA V-5.
 21. Threaded indexing to prevent interchange between services.
 22. Constructed to permit one-handed connection and removal of equipment.
 23. D.I.S.S. numbers in "Medical Vacuum" and "WAGD" subparagraphs below are for indicated vacuum only. Other D.I.S.S. numbers are for other gases.
 24. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.
 25. WAGD: CGA V-5, D.I.S.S. No. 2220.
- C. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.
- D. Cover Plates:
1. One piece.
 - a. Stainless steel.
 2. Permanent, color-coded, identifying label matching corresponding service.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cleaning of medical gas tubing for vacuum service is not required but is recommended for all copper medical gas tube and connected fittings to prevent mix-up of different piping systems during installation.
- B. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if pre-cleaned fittings or tubing must be re-cleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
- C. Revise procedures in subparagraphs below if required by authorities having jurisdiction.
- D. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
- E. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
- F. Scrub to ensure complete cleaning.

- G. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- C. Comply with NFPA 99 for installation of vacuum piping.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install vacuum piping with 1 percent slope downward in direction of flow.
- I. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- J. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver [and separator]. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- P. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

- Q. Retain "Piping Restraint Installation" Paragraph below if piping is required to withstand specific design loads.
- R. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- S. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- T. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
- U. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- V. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- W. Install unions in PVC vacuum piping NPS 2 (DN 50) and smaller adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- X. Install flanges in PVC vacuum piping NPS 2-1/2 (DN 65) and larger adjacent to flanged valves and at final connection to each machine, specialty, and piece of equipment.

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Apply appropriate tape to external pipe threads.
- E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

- F. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
- G. PVC-to-Copper Joints: Join transition fitting PVC socket end as solvent-cemented joint to PVC pipe and join fitting end with insert to copper tube as threaded joint.
- H. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2104, with tools recommended by tube manufacturer.
- I. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 - 2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- J. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
- K. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.
- L. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
- D. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
- E. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- F. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- G. Base of Vertical Piping: MSS Type 52, spring hangers.
- H. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting and coupling.

- I. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.
- J. Maximum spans in first paragraph below were taken from MSS SP-69 for copper tube and vapor service. Horizontal spacing also matches NFPA 99 for medical gas tubing.
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 - 8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 - 9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - 10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 - 11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - 12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
 - 13. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
 - 14. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
 - 15. Install supports for vertical copper tubing every 10 feet (3 m).
 - 16. Maximum spans in first paragraph below are suggested support spacing from the "Piping Databook," by Mohinder L. Nayyar, for Schedule 40 PVC pipe at 140 deg F (60 deg C).
- L. Install [vinyl-coated] hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 30 inches (760 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 42 inches (1150 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1220 mm) with 1/2-inch (13-mm) rod.

5. NPS 6 and NPS 8 (DN 150 and DN 200): 54 inches (1350 mm) with 5/8-inch (16-mm) rod.
6. Install supports for vertical PVC piping every 48 inches (1220 mm).

3.6 IDENTIFICATION

- A. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
- B. Medical Vacuum: Black letters on white background.
- C. WAGD: White letters on violet background.
- D. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
- E. HVE: Black boxed letters on white-and-black diagonal stripe background.
- F. Medical Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

- A. Tests and Inspections:
 1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping] systems.
 2. Tests in "Preparation" Subparagraph below are required by Installer before verification by testing agency.
 3. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 4. Initial blowdown.
 5. Initial pressure test.
 6. Cross-connection test.
 7. Piping purge test.
 8. Standing pressure test for vacuum systems.
 9. Repair leaks and retest until no leaks exist.
 10. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 11. Standing pressure test.
 12. [Individual-pressurization] [or] [pressure-differential] cross-connection test.

13. Valve test.
14. Master and area alarm tests.
15. Piping purge test.
16. Final tie-in test.
17. Operational vacuum test.
18. Verify correct labeling of equipment and components.
19. Revise "Testing Certification" Subparagraph below for exact testing certification required.
20. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
21. Inspections performed.
22. Procedures, materials, and gases used.
23. Test methods used.
24. Results of tests.
25. Remove and replace components that do not pass tests and inspections and re-test as specified above.

3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING

- A. Tests and Inspections:
1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 2. Test Pressure for Copper Tubing: [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert value>.
 3. Test Pressure for PVC Piping: [50 psig (345 kPa)] [100 psig (690 kPa)] <Insert value>.
 4. Repair leaks and retest until no leaks exist.
 5. Inspect filters for proper operation.
 6. Remove and replace components that do not pass tests and inspections and re-test as specified above.

3.9 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.

- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.10 PIPING SCHEDULE

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.
- B. Connect PVC pipe to copper tube with transition fittings.
- C. Flanges may be used where connection to flanged equipment is required.
- D. Medical Vacuum Piping: Use copper [medical gas] [water] tube, wrought-copper fittings, and brazed joints.
- E. WAGD Piping: Use copper [medical gas] [water] tube, wrought-copper fittings, and brazed joints.
- F. Dental Vacuum Piping: Use copper water tube, wrought-copper fittings, and soldered joints.
- G. Retain "one of" option in "HVE Piping" Paragraph below if retaining more than one subparagraph below in same size range to allow Contractor to select piping materials from those retained.

3.11 VALVE SCHEDULE

- A. Shutoff Valves:
 - 1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. PVC Piping:
 - 1. NPS 4 (DN 100) and Smaller: [Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions] [PVC ball valve].
 - 2. NPS 5 (DN 125) and Larger: PVC butterfly valve.
- C. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 22 62 13

SECTION 22 63 13 - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Gases in five subparagraphs below are suitable medical gases for healthcare facilities.
 - 2. Carbon dioxide piping, designated "medical carbon dioxide."
 - 3. Helium piping, designated "medical helium."
 - 4. Nitrogen piping, designated "medical nitrogen."
 - 5. Nitrous oxide piping, designated "medical nitrous oxide."
 - 6. Oxygen piping, designated "medical oxygen."
 - 7. <Insert specialty gas> piping, designated "specialty <Insert designation>."
- B. Owner-Furnished Material:
 - 1. Patient-service consoles.
 - 2. Ceiling columns.
 - 3. Ceiling-hose assemblies.
 - 4. Medical gas manifolds.
 - 5. Bulk medical gas storage tanks.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Submit complete manufacturer's specification pages for each piece of equipment.
 - 2. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping.
 - 3. Indicate pump type, capacity and power requirements.
 - 4. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted.
 - 5. Include NPSH curve when applicable.

- 6. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions:
 - 1. Submit mounting and support requirements.
- C. Manufacturer's Certificate:
 - 1. Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Gases in first five paragraphs below are suitable medical gases for healthcare facilities.
- B. Medical carbon dioxide operating at 50 to 55 psig (345 to 380 kPa).
- C. Medical helium operating at 50 to 55 psig (345 to 380 kPa).
- D. Medical nitrogen operating at 160 to 185 psig (1100 to 1275 kPa).
- E. Medical nitrous oxide operating at [50 to 55 psig (345 to 380 kPa)] <Insert values>.
- F. Medical oxygen operating at [50 to 55 psig (345 to 380 kPa)] <Insert values>.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 - 1. Medical compressed-air manifolds shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the manifold will remain in place without separation of any parts when subjected to the seismic forces and the manifold will be fully operational after the seismic event."
- C. For life safety components required to function after an earthquake (such as fire sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical gas piping materials.
- B. Copper Medical Gas Tube:
 - 1. ASTM B 819, [Type K] [and] [Type L], seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service.
 - 2. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
- C. Wrought-Copper Fittings:
 - 1. ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- D. Copper Unions:
 - 1. ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges:
 - 1. ASME B16.24, Class 150.
- F. Pipe-Flange Gasket Materials:
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
- G. Flange Bolts and Nuts:
 - 1. ASME B18.2.1, carbon steel.
- H. Shape-Memory-Metal Couplings:
 - 1. Manufacturers:
 - a. [Aerofit, Inc.](#)
 - b. [Smart Tap, Inc.](#)
 - 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals:
 - 1. AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape:
 - 1. PTFE.
- C. Solvent Cement for Joining PVC Piping:
 - 1. ASTM D 2564. Include primer complying with ASTM F 656.

2.5 VALVES

- A. General Requirements for Valves:
 - 1. Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

- B. Zone-Valve Box Assemblies:
 - 1. Box with medical gas valves, tube extensions, and gages.
- C. Zone-Valve Boxes:
 - 1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [Ohio Medical Corporation.](#)
- D. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
- E. Interior Finish: Factory-applied white enamel.
- F. Cover Plate: Stainless steel with frangible or removable windows.
- G. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- H. Ball Valves:
 - 1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Conbraco Industries, Inc.](#)
 - e. [Marwin Valve; a division of Richards Industries.](#)
 - f. [NIBCO INC.](#)
 - g. [Ohio Medical Corporation.](#)
 - h. [Tri-Tech Medical Inc.](#)
 - 2. Standard: MSS SP-110.
 - 3. Description: Three-piece body, brass or bronze.
 - 4. Pressure Rating: 300 psig (2070 kPa) minimum.
 - 5. Ball: Full-port, chrome-plated brass.
 - 6. Seats: PTFE or TFE.
 - 7. Retain locking-type handle in "Handle" Subparagraph below if required.
 - 8. Handle: Lever type with locking device.
 - 9. Stem: Blowout proof with PTFE or TFE seal.
 - 10. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.
- I. Check Valves:
 - 1. Manufacturers:

- a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Conbraco Industries, Inc.](#)
 - e. [Ohio Medical Corporation.](#)
 - f. [Tri-Tech Medical Inc.](#)
 2. Description: In-line pattern, bronze.
 3. Pressure Rating: 300 psig (2070 kPa) minimum.
 4. Operation: Spring loaded.
 5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
- J. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.
1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Ohio Medical Corporation.](#)
 - e. [Tri-Tech Medical Inc.](#)
 2. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
 3. Inlets in "Inlet" Subparagraph below are also available in NPS 1/2 and NPS 3/4 (DN 15 and DN 20).
 4. Inlet: Manufacturer-installed, NPS 1 or NPS 1-1/4 (DN 25 or DN 32), ASTM B 819, copper tubing with NPS 1 (DN 25) minimum ball valve.
- K. Safety Valve: Bronze-body pressure relief valve set at 75 or 80 psig (520 or 550 kPa).
- L. Instrumentation: Pressure gage.
- M. Safety Valves:
1. Bronze body.
 2. ASME-construction, poppet, pressure-relief type.
 3. Settings to match system requirements.
 4. Pressure Regulators:
 5. Stainless-steel body and trim.
 6. Spring-loaded, diaphragm-operated, relieving type.
 7. Manual pressure-setting adjustment.
 8. Rated for 250-psig (1725-kPa) minimum inlet pressure.

9. Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

N. MEDICAL GAS SERVICE CONNECTIONS

1. Manufacturers:
 - a. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - b. [Amico Corporation.](#)
 - c. [BeaconMedaes.](#)
 - d. [Ohio Medical Corporation.](#)
 - e. [Oxequip Health Industries; a division of Allied Healthcare Products Inc.](#)
 - f. [Tri-Tech Medical Inc.](#)
2. General Requirements for Medical Gas Service Connections:
3. Suitable for specific medical gas pressure and suction service listed.
4. Include roughing-in assemblies, finishing assemblies, and cover plates.
5. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
6. Recessed-type units made for concealed piping unless otherwise indicated.
7. Roughing-in Assembly:
 - a. Steel outlet box for recessed mounting and concealed piping.
 - b. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
 - c. Double seals that will prevent gas leakage.
 - d. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
8. Finishing Assembly:
 - a. Brass housing with primary check valve.
 - b. Double seals that will prevent gas leakage.
 - c. Cover plate with gas-service label.
 - d. Wall service connections are typically quick-coupler type for new projects. Match existing outlet type if required.
- O. Quick-Coupler Pressure Service Connections: Outlets for nitrous oxide and oxygen with non-interchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
- P. Quick-Coupler Pressure Service Connections: Outlets for medical air and instrument air with non-interchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
- Q. Quick-Coupler Suction Service Connections: Inlets for medical vacuum with non-interchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

- R. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1. Medical Carbon Dioxide: D.I.S.S. No. 1080.
 - 2. Medical Helium: D.I.S.S. No. 1060.
 - 3. Medical Nitrogen: D.I.S.S. No. 1120.
 - 4. Medical Nitrous Oxide: D.I.S.S. No. 1040.
 - 5. Medical Oxygen: D.I.S.S. No. 1240.
- S. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1. Medical Air: D.I.S.S. No. 1160.
 - 2. Instrument Air: D.I.S.S. No. 1160.
- T. D.I.S.S. Suction Service Connections: Inlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1. Medical Vacuum: D.I.S.S. No. 1220.
 - 2. WAGD: D.I.S.S. No. 2220.
- U. Cover Plates: One piece, stainless steel and permanent, color-coded, identifying label matching corresponding service.

2.6 PATIENT-SERVICE CONSOLES

- A. Manufacturers:
 - 1. [Amico Corporation](#).
 - 2. [BeaconMedaes](#).
 - 3. [Tri-Tech Medical Inc.](#)
- B. Standard: UL 60601.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. General Requirements for Patient-Service Consoles: Wall units with service connections. Include labels indicating services, and the following:
- E. Steel console box or mounting bracket.
- F. Concealed supplies.
- G. Cover: One piece, stainless steel and permanent identifying label.

- H. Medical gas service connections as specified in "Medical Gas Service Connections" Article.
- I. Coordinate "Medical Oxygen," "Medical Air," "Medical Vacuum," and "Medical Vacuum Bottle Bracket(s)" subparagraphs below with Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" and Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities."
- J. Medical Oxygen: One (1) quick-coupler D.I.S.S. No. 1240 pressure outlet(s).
- K. Medical Air: One (1) quick-coupler D.I.S.S. No. 1160 Quick-coupler pressure outlet(s).
- L. Medical Vacuum: One (1) quick-coupler D.I.S.S. No. 1220 suction inlet(s).
- M. Medical Vacuum Bottle Bracket(s): One (1).
- N. Electrical Service Connections:
 - 1. General Requirements for Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Power Outlets: UL 498, Hospital Grade, 125-V ac, [single] [duplex] receptacle(s) [in color selected by Architect]. Include the following configurations complying with NEMA WD 1:
 - 3. [One] <Insert number> L5-20R, locking type, 20 A, single or duplex.
 - 4. [One] <Insert number> L5-20R, isolated ground, locking type, 20 A, single or duplex.
- O. <Insert outlet type>.
- P. Electrical Accessory Outlets: Provide the following configured receptacles [in color selected by Architect]:
- Q. Patient Equipment Ground Jack: [One] <Insert number>, single pole, 30 A.
- R. Patient Monitoring: [One] <Insert number>, single, [five] [and] [37] <Insert number> pin.
- S. <Insert outlet type>.
- T. Outlet Cover Plates: One piece, [aluminum] [or] [stainless steel] and permanent identifying label.

2.7 MEDICAL NITROGEN PRESSURE CONTROL PANELS

- A. Manufacturers:
 - 1. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 - 2. [Amico Corporation.](#)
 - 3. [BeaconMedaes.](#)
 - 4. [Ohio Medical Corporation.](#)

5. [Tri-Tech Medical Inc.](#)
- B. Steel box and support brackets for recessed roughing-in with stainless-steel or anodized-aluminum cover plate with printed operating instructions.
- C. Manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
- D. Minimum Working Pressure: [200 psig (1380 kPa)] <Insert value>.
- E. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
- F. Pressure Gages: 0 to 300 psig (0 to 2070 kPa).
- G. Service Connection: CGA V-5, D.I.S.S. No. 1120, nitrogen outlet.
- H. Before final assembly, provide temporary dust shield and U-tube for testing.
- I. Label cover plate "Nitrogen Pressure Control."

2.8 CEILING COLUMNS

- A. Manufacturers:
 1. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 2. [Amico Corporation.](#)
 3. [BeaconMedaes.](#)
 4. [Ohio Medical Corporation.](#)
 5. [Tri-Tech Medical Inc.](#)
- B. Standard: UL 60601.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. General Requirements for Ceiling Columns: Ceiling-mounted units with service connections. Include labels indicating services.
- E. Ceiling-Mounted Plate: Manufacturer's standard plate or roughing-in assembly.
- F. Exposed Surfaces: Minimum 0.0375-inch- (0.95-mm-) thick stainless steel.
- G. Servicing: Include access panels or means of removing shroud.
- H. Blank cover plates for cutouts not having service connections.

- I. ASTM B 819, NPS 3/8 (DN 10) copper-tube extensions for connection to medical gas systems.
- J. Service Connections: Type and number indicated.
- K. Dust Covers: For medical gas service connections.
- L. Retain one of two "Description" subparagraphs below. First subparagraph is for retractable ceiling columns.

Description: Manually adjustable using release and lock handles capable of locking column in all positions from fully retracted to fully extended; [15-inch- (380-mm-)] <Insert dimension> long, rectangular, counterbalanced, telescoping section with [two] [four] <Insert number> double intravenous medication hooks; and [36-inch- (915-mm-)] <Insert dimension> long fixed column section. Include 0.078-inch- (2.0-mm-) thick, stainless-steel bottom plate with medical gas and electrical service connections as required.

"Description" Subparagraph below is for stationary ceiling columns. Revise length of service column for required height above floor to bottom of unit.

Description: [44-inch- (1120-mm-)] <Insert dimension> long, rectangular stationary column section with [two] [four] <Insert number> double intravenous medication hooks. Include 0.078-inch- (2.0-mm-) thick, stainless-steel bottom plate with medical gas and electrical service connections as required.

- M. Medical Gas Service Connections: As specified in "Medical Gas Service Connections" Article.
 - 1. **Revise number and type of service connections required in "Medical Carbon Dioxide," "Medical Helium," "Medical Nitrogen," "Medical Nitrous Oxide," "Medical Oxygen," "Instrument Air," "Medical Air," "Medical Vacuum," "Medical Vacuum Bottle Brackets," "WAGD," and "Insert medical gas" subparagraphs below. Service connections can also be side mounted.**
 - a. Medical Carbon Dioxide: [One] <Insert number> [quick-coupler] [D.I.S.S. No. 1080] pressure outlet(s).
 - b. Medical Helium: [One] <Insert number> D.I.S.S. No. 1060 pressure outlet(s).
 - c. Medical Nitrogen: [One] <Insert number> D.I.S.S. No. 1120 pressure outlet(s).
 - d. Medical Nitrous Oxide: [One] <Insert number> [quick-coupler] [D.I.S.S. No. 1040] pressure outlet(s).
 - e. Medical Oxygen: [Two] <Insert number> [quick-coupler] [D.I.S.S. No. 1240] pressure outlets.
 - f. Instrument Air: [One] <Insert number> D.I.S.S. No. 1160 pressure outlet(s).
 - g. Medical Air: [One] <Insert number> [quick-coupler] [D.I.S.S. No. 1160] pressure outlet(s).
 - h. Medical Vacuum: [Two] <Insert number> [quick-coupler] [D.I.S.S. No. 1220] suction inlets.
 - i. Medical Vacuum Bottle Brackets: [Two] <Insert number>.
 - j. WAGD: [One] <Insert number> [quick-coupler] [D.I.S.S. No. 2220] suction inlet(s).
 - k. <Insert medical gas>: <Insert number and type>.
- N. Electrical Service Connections:

1. General Requirements for Electrical Components, Devices, and Accessories:
Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - a. Power Outlets: UL 498, Hospital Grade, 125-V ac, [single] [duplex] receptacle(s) [; in color selected by Architect]. Include the following configurations complying with NEMA WD 1:
 - 1) [One] [Two] <Insert number> L5-20R, locking type, 20 A, single or duplex.
 - 2) [One] [Two] <Insert number> L5-20R, isolated ground, locking type, 20 A, single or duplex.
<Insert outlet type>.
 - b. If explosive anesthesia is used, retain first subparagraph below.
[One] [Two] <Insert number> explosion proof, 20 A, two pole, three wire, single; suitable for Class I, Group C hazardous location and interchangeable with receptacles used in nonhazardous areas; flush mounted.
<Insert outlet type>.
 - c. Retain types in first two subparagraphs below for side mounting only.
[One] [Two] <Insert number> 5-20R, straight blade, 20 A, duplex.
[One] [Two] <Insert number> 5-20R, isolated ground, straight blade, 20 A, duplex.
<Insert outlet type>.
- O. Electrical Accessory Outlets:
 1. Provide the following configured receptacles [in color selected by Architect]:
 - a. Patient Equipment Ground Jack: [One] <Insert number>, single pole, 30 A.
 - b. Patient Monitoring: [One] <Insert number>, single, [five] [and] [37] <Insert number> pin.
<Insert outlet type>.
 - c. Outlet Cover Plates: One piece, [aluminum] [or] [stainless steel] and permanent identifying label.

2.9 CEILING-HOSE ASSEMBLIES

- A. Indicate on Drawings number and type of services required, coordinate electrical requirements with electrical Drawings, and coordinate this article with medical equipment specifications and architectural Drawings. Other variations are available.
- B. Hose assemblies in "Ceiling-Hose Assemblies" Paragraph below are available as individual service connections and may be installed together for up to six service connections. Hoses as long as 20 feet (6 m) are available.

Copy "Ceiling-Hose Assemblies" Paragraph below and re-edit for each type of hose-reel ceiling-hose assembly required.

Insert number to complete drawing designation. Use these designations on Drawings to identify each ceiling-hose assembly.
Ceiling-Hose Assemblies <Insert drawing designation>: [Fixed-position, suspended hose] [Hose-reel retractable hose].

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

- C. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

- D. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

1. [Allied Healthcare Products Inc.; Chemetron Division.](#)
2. [Amico Corporation.](#)
3. [BeaconMedaes.](#)
4. [Ohio Medical Corporation.](#)
5. [Tri-Tech Medical Inc.](#)
<Insert manufacturer's name>.

- E. General Requirements for Ceiling-Hose Assemblies: Ceiling-mounted units with service connections. Include labels indicating services.

1. Ceiling-Mounted Plate: Manufacturer's standard plate or roughing-in assembly.
Exposed Surfaces: Minimum 0.0375-inch- (0.95-mm-) thick stainless steel.
2. Servicing: Include access panels or means of removing shroud.
Blank cover plates for cutouts not having service connections.
ASTM B 819, NPS 3/8 (DN 10) copper-tube extensions for connection to medical gas systems.
3. Service Connections: Type and number indicated.
4. Dust Covers: For medical gas service connections.
Retain one of two "Description" subparagraphs below. First subparagraph is for fixed-position, suspended-hose service assemblies that are available with one or two service connections; two assemblies may be installed together for up to four service connections.
5. Description: Individual, concealed, suspended-hose connection with stainless-steel faceplates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with retractor device and service connections matching hoses. Include [72 inches (1830 mm)] <Insert dimension> of conductive, CR, 1/4- or 5/16-inch (6.4- or 7.9-mm) ID, medical gas hoses rated for 200-psig (1380-kPa) minimum working pressure, and medical gas and electrical service-hose connections as required.

"Description" Subparagraph below is for hose-reel, retractable hose service assemblies.

Description: Individual, concealed, hose reel with retractable hose with stainless-steel faceplates, steel mounting boxes, factory- or field-fabricated mounting

brackets, and color-coded service hoses with adjustable stops and service connections matching hoses. Include [15 feet (4.5 m)] <Insert dimension> minimum of conductive, CR, 1/4- or 5/16-inch (6.4- or 7.9-mm) ID, medical gas hoses rated for 200-psig (1380-kPa) minimum working pressure, and medical gas and electrical service-hose connections as required.

6. Medical Gas Service Connections:
 - a. All medical gas, electrical, and water service connections are available but with combination restrictions. See manufacturers' catalogs. Retain up to six service connections in nine subparagraphs below. Coordinate "Instrument Air," "Medical Air," "Medical Vacuum," and "WAGD" subparagraphs with Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" and Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities."
 - 1) Medical Carbon Dioxide: [Quick-coupler] [D.I.S.S. No. 1080] pressure outlet.
 - 2) Medical Nitrogen: D.I.S.S. No. 1120 pressure outlet.
 - 3) Medical Nitrous Oxide: [Quick-coupler] [D.I.S.S. No. 1040] pressure outlet.
 - 4) Medical Oxygen: [Quick-coupler] [D.I.S.S. No. 1240] pressure outlet.
 - 5) Instrument Air: D.I.S.S. No. 1160 pressure outlet.
 - 6) Medical Air: [Quick-coupler] [D.I.S.S. No. 1160] pressure outlet.
 - 7) Medical Vacuum: [Quick-coupler] [D.I.S.S. No. 1220] suction inlet.
 - 8) WAGD: [Quick-coupler] [D.I.S.S. No. 2220] suction inlet.
<Insert medical gas>: <Insert number and type>.
7. Electrical Service Connections:
 - a. General Requirements for Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - b. Power Outlets: UL 498, Hospital Grade, 125-V ac, NEMA WD 1, [L5-20R, locking-type, 20-A] [L5-20R, isolated-ground, locking-type, 20-A] single-receptacle configuration.

2.10 MEDICAL GAS MANIFOLDS

- A. Manufacturers:
 1. [Acme Cryogenics.](#)
 2. [Allied Healthcare Products Inc.; Chemetron Division.](#)
 3. [Amico Corporation.](#)
 4. [BeaconMedaes.](#)
 5. [Ohio Medical Corporation.](#)
 6. [Tri-Tech Medical Inc.](#)
<Insert manufacturer's name>.

Comply with NFPA 99 for high-pressure medical gas cylinders.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Central Control-Panel Unit:
 - 1. Weatherproof cabinet.
 - 2. Supply and delivery pressure gages.
 - 3. Electrical alarm-system connections and transformer.
 - 4. Indicator lights or devices.
 - 5. Manifold connection.
 - 6. Pressure changeover switch.
 - 7. Line-pressure regulator.
 - 8. Shutoff valves.
 - 9. Safety valve.
- C. Manifold and Headers:
 - 1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
 - 2. Designed for [2000-psig (13.8-MPa)] <Insert value> minimum inlet pressure except nitrous oxide manifolds may be designed for [800 psig (5520 kPa)] <Insert value> and carbon dioxide manifolds may be designed for [1500 psig (10.35 MPa)] <Insert value>.
 - 3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
 - 4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
- D. Operation:
 - 1. Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
- E. Mounting: [Wall with mounting brackets for manifold control cabinet and headers] [Floor with support legs for manifold control cabinet].
Use label in first paragraph below with nonstandard system pressures. Label can also indicate special service requirements.
 - 1. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.
- F. Medical Carbon Dioxide Manifolds:
 - 1. For [two] [four] <Insert number> cylinders and [55-psig (380-kPa)] <Insert value> line pressure.
- G. Medical Helium Manifolds:
 - 1. For [two] [four] <Insert number> cylinders and [55-psig (380-kPa)] <Insert value> line pressure.
- H. Medical Nitrogen Manifolds:

1. For [eight] [12] <Insert number> cylinders and [180-psig (1240-kPa)] [higher than 200-psig (1380-kPa)] <Insert value> line pressure.
- I. Medical Nitrous Oxide Manifolds:
 1. For [eight] [12] <Insert number> cylinders and [55-psig (380-kPa)] <Insert value> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
- J. Medical Oxygen Manifolds:
 1. For [12] [20] <Insert number> cylinders and [55-psig (380-kPa)] <Insert value> line pressure.
- K. Medical Gas Cylinders:
 1. [Furnished by Owner] [Number and type of medical gas cylinders required for complete manifold systems] <Insert requirement>.

2.11 SIMPLEX SPECIALTY GAS MANIFOLDS

Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. [Acme Cryogenics.](#)
 - b. [Airgas, Inc.](#)
 - c. [Air Liquide America Specialty Gases LLC.](#)
 - d. [Air Products and Chemicals, Inc.](#)
 - e. [BeaconMedaes.](#)
 - f. [BOC Gases.](#)
 - g. [GTS-Welco.](#)
 - h. [Linde North America Inc.](#)
 - i. [Matheson Tri-Gas.](#)
 - j. [Praxair Technology, Inc.](#)
 - k. [Spectra Gases, Inc.](#)
 - l. <Insert manufacturer's name>.
- B. Electrical Components, Devices, and Accessories:
 1. Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Control-Panel Unit:
 1. Weatherproof cabinet, supply and delivery pressure gages, electrical alarm-system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
- D. Manifold and Header:
 1. Nonferrous-metal header for number of cylinders indicated.

2. Units include design for [2000-psig (13.8-MPa)] <Insert value> minimum inlet pressure, cylinder-bank header with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
- E. Mounting: [Wall with mounting brackets for manifold control cabinet and header] [Floor with support legs for manifold control cabinet].
 1. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.

Copy "<Insert specialty gas> Manifold" Paragraph below and re-edit for each simplex specialty gas manifold. Insert or delete manifold types below to suit Project.
- F. <Insert specialty gas> Manifold:
 1. For one cylinder and [55-psig (380-kPa)] <Insert value> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
- G. Specialty Gas Cylinders:
 1. [Furnished by Owner] [Number and type of specialty gas cylinders required for complete manifold systems] <Insert requirement>.

2.12 DUPLEX SPECIALTY GAS MANIFOLDS

Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. [Acme Cryogenics.](#)
 - b. [Airgas, Inc.](#)
 - c. [Air Liquide America Specialty Gases LLC.](#)
 - d. [Air Products and Chemicals, Inc.](#)
 - e. [BeaconMedaes.](#)
 - f. [BOC Gases.](#)
 - g. [GTS-Welco.](#)
 - h. [Linde North America Inc.](#)
 - i. [Matheson Tri-Gas.](#)
 - j. [Praxair Technology, Inc.](#)
 - k. [Spectra Gases, Inc.](#)
 - l. <Insert manufacturer's name>.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 1. Central Control-Panel Unit:

- a. Weatherproof cabinet, supply and delivery pressure gages, electrical alarm-system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
 2. Manifold and Headers:
 - a. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for [2000-psig (13.8-MPa)] <Insert value> minimum inlet pressure, cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
 3. Operation:
 - a. Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
 4. Mounting: [Wall with mounting brackets for manifold control cabinet and headers] [Floor with support legs for manifold control cabinet].
 - a. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.
- Copy "<Insert specialty gas> Manifold" Paragraph below and re-edit for each duplex specialty gas manifold. Insert or delete manifold types below to suit Project.
5. <Insert specialty gas> Manifold:
 - a. For two cylinders and [55-psig (380-kPa)] <Insert value> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
 6. Specialty Gas Cylinders:
 - a. [Furnished by Owner] [Number and type of specialty gas cylinders required for complete manifold systems] <Insert requirement>.

2.13 BULK MEDICAL GAS STORAGE TANKS

Retain this article to require Contractor to provide bulk storage tanks. Tanks are usually provided by gas supplier, or the healthcare facility will have a bulk oxygen storage system and may have a bulk nitrous oxide storage system. Bulk gas storage tanks are also available, if required, for specialty gases.

- A. General Requirements for Bulk Medical Gas Storage Tanks:

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.
- B. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]: Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. Acme Cryogenics.
 - b. Chart Industries, Inc.
 - c. Taylor-Wharton-Cryogenics.
 - d. <Insert manufacturer's name>.

Comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1; and NFPA 99.

Include bulk storage tank with connections for alarm system, continuous supply, and reserve supply that will operate only during emergencies.

C. Controls:

1. Include actuating switch for alarm-system connection and means for automatic actuating of reserve supply.

D. Bulk Medical Gas Storage Tanks:

1. Vertical mounted, double-wall construction with inner vessel fabricated according to ASME Boiler and Pressure Vessel Code for unfired pressure vessels and suitable for medical gas service. Include insulation and vacuum seal between walls. Fabricate outer shell from carbon steel with factory-applied manufacturer's standard protective paint finish suitable for exterior installation. Include the following features, specialties, and components:

E. Safety Valves:

1. ASME construction with pressure setting to correspond to tank working pressure and as required for component or system being protected.

F. Pressure Gages:

1. For tank pressure and facility service-line pressure.

G. Contents Gage:

1. High- and low-level indicator with electric signal circuit connection.

H. Drain Valves:

1. For piping, inner vessel, and outer shell.

I. Fill Assembly:

1. Fill connection, piping, valves, relief devices, and controls.

J. Facility Service Assembly:

1. Piping, valves, relief devices, vaporizer, shutoff valve, pressure regulator, line shutoff valve or check valve, and reserve supply connection for connection to building service piping.

Permanent label showing medical gas type, storage-tank capacity, tank pressure rating, vaporizer capacity, and operating instructions.

K. Liquid Oxygen Storage Tank:

1. Comply with NFPA 50 for bulk oxygen storage tanks.

L. Construction:

1. Nickel-steel or stainless-steel inner vessel with [250-psig (1725-kPa)] <Insert value> minimum working pressure.

Retain "Steam" option in "Vaporizer Type" Subparagraph below for large flow if available; otherwise, retain "Electric" option. Retain "Ambient" option for small flow.

- M. Vaporizer Type: [Electric] [Steam] [Ambient].
- N. Storage-Tank Capacity: [As indicated] <Insert value>.
- O. Vaporizer Capacity: [As indicated] <Insert value>.
- P. Oxygen Reserve Supply:
1. Manifold header for high-pressure cylinders fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to [4000 psig (27.6 MPa)] <Insert value>. Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, and inlet connections for <Insert number> cylinders indicated.
- Q. Liquid Nitrous Oxide Storage Tank:
1. Comply with CGA G-8.1 for bulk nitrous oxide storage tanks.
- R. Construction:
1. Steel-alloy inner vessel with [300-psig (2070-kPa)] <Insert value> minimum working pressure.
- Retain "Steam" option in "Vaporizer Type" Subparagraph below for large flow if available.
- S. Vaporizer Type: [Electric] [Steam].
- T. Storage Tank Capacity: [As indicated] <Insert value>.
- U. Vaporizer Capacity: [As indicated] <Insert value>.
- V. Nitrous Oxide Reserve Supply:
1. Manifold header for high-pressure cylinders fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to [4000 psig (27.6 MPa)] <Insert value>. Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, inlet connections for <Insert number> cylinders indicated, and electric heater.

2.14 GAS CYLINDER STORAGE RACKS

Retain this article if storage racks are required; detail storage racks on Drawings.

- A. Wall Storage Racks:
1. Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
- B. Freestanding Storage Racks:
1. Fabricate racks as indicated or provide equivalent manufactured storage racks.

2.15 NITROGEN

- A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if pre-cleaned fittings or tubing must be re-cleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - B. Revise procedures in subparagraphs below if required by authorities having jurisdiction.
 - C. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
 - D. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
 - E. Scrub to ensure complete cleaning.
 - F. Rinse with clean, hot water to remove cleaning solution.

3.2 EARTHWORK

- A. Retain this article for projects with outdoor bulk storage tanks requiring underground piping outside the building.
- B. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling and for underground warning tapes.

3.3 PIPING INSTALLATION

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- C. Comply with NFPA 99 for installation of medical gas piping.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install piping to permit valve servicing.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and for branch connections.
- L. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
- M. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.
- N. Retain "Piping Restraint Installation" Paragraph below if piping is required to withstand seismic design loads.
- O. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- P. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- Q. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
- R. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 VALVE INSTALLATION

- A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on gas piping where reduced pressure is required.
- F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

3.5 JOINT CONSTRUCTION

- A. Ream ends of PVC pipes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.
- F. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

3.6 GAS SERVICE COMPONENT INSTALLATION

- A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.
- B. Install nitrogen pressure-control panels in walls. Attach to substrate.

- C. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
- D. Assemble ceiling-hose assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
- E. Install gas manifolds [on concrete base] anchored to substrate.
- F. Retain first paragraph below if Contractor provides gas cylinders.
- G. Install gas cylinders and connect to manifold piping.
- H. Indicate seismic restraints on Drawings if required, or delete first paragraph below.
- I. Install gas manifolds with seismic restraints.
- J. Retain option in first paragraph below if bulk oxygen storage tank is specified.
- K. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks [according to applicable requirements in NFPA 50 for bulk oxygen storage systems]. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 50 and tank manufacturer's recommended clearances. Orient tanks so controls and devices are accessible for servicing.
- L. Indicate seismic restraints on Drawings if required, or delete paragraph below.
- M. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Retain first paragraph below if Project requires seismic design.
- B. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- D. Vertical Piping: MSS Type 8 or Type 42, clamps.
- E. Individual, Straight, Horizontal Piping Runs:
- F. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
- G. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- H. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- I. Base of Vertical Piping: MSS Type 52, spring hangers.

- J. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting and coupling.
- K. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.
- L. Maximum spans in remainder of this article were taken from MSS SP-69 for copper tube and vapor service. Horizontal spacing also matches NFPA 99 for medical gas tubing.
- M. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 - 8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 - 9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - 10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 - 11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - 12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
 - 13. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
 - 14. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
 - 15. Install supports for vertical copper tubing every 10 feet (3 m).

3.8 IDENTIFICATION

- A. Install identifying labels and devices for specialty gas piping, valves, and specialties.
- B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - C. Carbon Dioxide: Black or white letters on gray background.
 - D. Helium: White letters on brown background.
 - E. Nitrogen: White letters on black background.

- F. Nitrous Oxide: White letters on blue background.
- G. Oxygen: White letters on green background or green letters on white background.

3.9 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

- A. Tests and Inspections:
 - 1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
- B. Tests in "Preparation" Subparagraph below are required by Installer before verification by testing agency.
- C. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - 1. Initial blowdown.
 - 2. Initial pressure test.
 - 3. Cross-connection test.
 - 4. Piping purge test.
 - 5. Standing pressure test for positive-pressure medical gas piping.
 - 6. Standing pressure test for vacuum systems.
 - 7. Repair leaks and retest until no leaks exist.
 - 8. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - 9. Standing pressure test.
 - 10. [Individual-pressurization] [or] [pressure-differential] cross-connection test.
 - 11. Valve test.
 - 12. Master and area alarm tests.
 - 13. Piping purge test.
 - 14. Piping particulate test.
 - 15. Piping purity test.
 - 16. Final tie-in test.
 - 17. Operational pressure test.
 - 18. Medical gas concentration test.
 - 19. Medical air purity test.

20. Verify correct labeling of equipment and components.
21. Verify medical gas supply sources.
22. Revise "Testing Certification" Subparagraph below for exact testing certification required.
23. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
24. Inspections performed.
25. Procedures, materials, and gases used.
26. Test methods used.
27. Results of tests.
28. Remove and replace components that do not pass tests and inspections and re-test as specified above.
29. Prepare test and inspection reports.

3.10 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

- A. Tests and Inspections:
 1. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 2. Repair leaks and retest until no leaks exist.
 3. Inspect specialty gas regulators for proper operation.
 4. Remove and replace components that do not pass tests and inspections and re-test as specified above.
 5. Prepare test and inspection reports.

3.11 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.12 DEMONSTRATION

- A. Retain this article only if bulk gas storage tanks are specified in this Section.

- B. Engage factory-authorized service representative to train. Owner's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.

3.13 PIPING SCHEDULE

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Piping in first paragraph below includes medical carbon dioxide, medical helium, medical nitrous oxide, and medical oxygen.
- C. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper tube; wrought-copper fittings; and brazed joints.
- D. Medical Nitrogen Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type K, copper tube; wrought-copper fittings; and brazed joints.
- E. Specialty Gas Piping except Specialty Gas Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper tube; wrought-copper fittings; and brazed joints.
- F. Specialty Gas Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type K, copper tube; wrought-copper fittings; and brazed joints.
- G. Protective Conduit: PVC pipe, PVC fittings, and solvent-cemented joints.

3.14 VALVE SCHEDULE

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 22 63 13

SECTION 22 67 13 – HIGH PURITY WATER SYSTEMS (RO)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. The water conditioning system/supplier shall be totally responsible for the supply and installation of the water treatment system to include the central RO water system, the building supply and return loop system, the final connection to the RO water outlet and quality assurance/quality controls of the entire system to assure meeting quality standards for CAP/NCCLS reagent water Specifications Type III at the point of use.
- B. The system/supplier shall guarantee that the water quality coming from the central system is the same quality at any point of use in the RO water loop system at initial start-up.
- C. Provide an RO system with capacities and electrical characteristics as scheduled on Contract Drawings. Scheduled gallons per day (24 hour period) shall be based on a feed water temperature of 77 degrees F.

1.4 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. Current Edition of the International Plumbing Code.
 - 2. Texas Water Code Chapter 37
 - 3. Texas Health & Safety Code Chapter 341
 - 4. Title 30 Texas Administrative Code, Chapter 30, Subchapter H
 - 5. Underwriters Laboratories Listings.
 - 6. Current Edition of the National Electric Code
 - 7. ASME - Boiler and Pressure Vessel Code.
 - 8. ASTM D 3222 - Standard Specifications for Unmodified PVDF molding material.
 - 9. ASTM D 638 - Standard Test Method for Tensile Properties of Plastic.

10. ASTM D 790 - Standard Test Method of Flexural Properties of Unreinforced and Reinforced Plastics and Electric Insulating Materials

1.5 QUALITY ASSURANCE

- A. Manufacturer's name and contact information shall be permanently marked on equipment.
- 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. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.
- D. Installer Qualifications:
 - 1. Company shall have minimum three years documented experience specializing in performing the Work of this section and be licensed by the State of Texas to install water treatment equipment.
 - 2. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.
 - 3. Site personnel, involved with PVDF piping installation, shall undergo training and certification from an authorized manufacturer's representative prior to performing any jointing operations on site. Each welder shall be fully trained on the welding equipment for the particular project and will be required to demonstrate the full process of welding. Training shall include set up of the tool, loading of the pipe and fittings, alignment of the tool, and the weld process. Training will also include minor maintenance techniques to keep tools in ideal operating conditions.
 - 4. All installers of water treatment equipment must meet the qualifications and be licensed according to the State of Texas.

1.6 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 WARRANTY

- A. Warranty: Include, but not limited to, coverage for the RO water system, storage tank, pumps, softener system, all associated controls and accessories.

- B. The system/supplier shall be responsible for the operation of the water treatment system for a period of one year from the date of Substantial Completion. During this period the system/supplier shall also be responsible for periodic ongoing training of the building maintenance personnel. The vendor shall supply all the necessary consumables for the first year of operation and include the labor to change out the consumables. A daily log indicating the performance of the system will be kept by the building maintenance personnel and reviewed by the system/supplier on a monthly basis.

1.9 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. The RO water central system will consist of the following components and include the interconnecting piping, valves, fittings, instrumentation, control wiring and electrical wiring to the equipment.
 - 1. Piping, Valves, Fittings
 - 2. Multi-layer Filter
 - 3. Activated Carbon Filter
 - 4. Water Softeners
 - 5. Reverse Osmosis System
 - 6. Storage Tank
 - 7. Level Controllers
 - 8. Re-pressurization Variable Speed Pumps
 - 9. Ultraviolet Sterilizers
 - 10. Final Filters
 - 11. Instrumentation
 - 12. Control Panel.
- C. Acceptable manufacturers:
 - 1. Marlo,
 - 2. Watertech,
 - 3. Culligan,
 - 4. Rainsoft or Owner Approved Equivalent.

2.2 PIPING, VALVES AND FITTINGS

- A. Pipe, valves and fittings from the reverse osmosis unit to include the supply and return building loop system shall be flame resistant, self-extinguishing polyvinylidene fluoride (PVDF) with heat fusion socket or IR connections.
- B. Installation practices, including support spacing and joint fusion shall be compliant with manufacturer's printed recommendations.
- C. Material from which pipe, fitting and valves are manufactured shall conform to the standards of ASTM D 3222. The PVDF material shall have a tensile strength of 7,800 psi and a flexural strength of 10,750 psi when tested at 73°F according to ASTM D 638 and

ASTM D 790, meeting 25/50 flame and smoke spread requirements of ASTM E84 and UL910, and shall be as manufactured by George Fischer Company or Asahi.

- D. To ensure installation uniformity, all system piping components shall be the products of one manufacturer.
- E. All piping shall be thoroughly rinsed and flushed to remove all dirt and debris before installation. After installation the Contractor shall flush the entire piping system with RO water to the satisfaction of the Owner.
- F. Valves shall be manufactured of the same virgin, unpigmented molding compound as the fittings to assure compatibility.
- G. Valves used for shutoff purposes shall be ball type valves. Ball valves shall be true union style, factory tested to 150 psi at 73°F, same material as pipe with socket or IR ends, blow-out proof stem, Teflon seats, EPDM seals, fully compatible with specified pipe, manufactured by George Fischer Model 546, or approved equivalent.
- H. Valves used for balancing purposes shall be diaphragm type valves, the diaphragm valves shall have PVDF body, PFA diaphragm, seals, and seats. Valves shall carry a pressure rating of 150 psi at a minimum of 68°F, and shall be of socket fusion or IR design as manufactured by George Fischer Company Model 515 or approved equivalent
- I. Check valves shall be true union style ball check type valves, same material as piping system, with socket or IR ends, EPDM O-ring and seals, 150 psi pressure rating at 68°F, manufactured by George Fischer No. 561, or approved equivalent.
- J. The reverse osmosis pretreatment equipment shall be piped by the system/supplier with rigid copper tubing and joints using "lead free" solder as specified for domestic water. Provide sample ports for the source, product and reject water lines. A pressure gauge and test port shall be provided before and after each piece of equipment. Each unit shall be installed using a "H" type 3-valve bypass. The person doing this installation or person supervising this installation must possess a currently valid Texas Department of Health Class III Certificate.
- K. Acceptable manufacturers:
 - 1. George Fisher,
 - 2. Kynar,
 - 3. Asahi,
 - 4. Orion (Watts) or Owner Approved Equivalent

2.3 PREFILTER ASSEMBLY

- A. Provide two sediment type filters assemblies. Each filter assembly shall consist of a replaceable filter cartridge and housing. Each filter cartridge shall be rated for nominal 20 microns with a minimum flow rate of gpm. The housing shall be reinforced FDA grade polypropylene sealed with top seated Buna-N O-ring, complete with mounting bracket and pressure relief button. Housing shall have threaded inlet and outlets.
- B. Acceptable manufacturers:
 - 1. Marlo,
 - 2. Watertech,
 - 3. Culligan,
 - 4. Rainsoft or Owner Approved Equivalent.

2.4 ACTIVATED CARBON FILTER

- A. Provide an activated carbon filter that shall reduce chlorine from the water to a level not to exceed <0.1 ppm (0.1 mg/l) as determined by an accepted water analysis of the treated water when the unit is operated at design flow and in accordance with operating instructions. In order to provide TOC reduction a maximum flow of 1 GPM per cubic foot of carbon. Tank shall be of fiberglass reinforced plastic construction rated for 100 psig working pressure and hydrostatically tested at 50% in excess of the working pressure. Tank shall have threaded NPT connections on the service inlet and outlet with pressure gauges and sampling cocks on the inlets and outlets.
- B. Upper distribution system shall be of the baffle type to evenly distribute the water over the entire tank area. Lower distribution the water over the entire tank area. Lower distribution system shall be of a proven design constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the media bed. Slotted lateral arms are unacceptable. The distribution system shall be embedded in a single layer subfill of washed 1/8" x 1/16" gravel to support the resin bed.
- C. Sequence control valve shall be of brass construction and shall operate on commands from the valve controller, with an internal automatic by-pass of the untreated water during backwash.
 - 1. The main operating valve shall be an industrial automatic multiport diaphragm type, slow opening and closing, free of water hammer. There shall be no contact of dissimilar metals within the valve and no special tools shall be required to service the valve.
 - 2. The main operating valve shall be of the same manufacturer as the filter.
 - 3. Valve shall have a treated water sampling cock.
 - 4. An automatic flow controller shall be provided to maintain proper backwash and flush rates over wide variation in operating pressures and require no field adjustment
- D. The control valve shall be automatic, fully adjustable, electro-mechanical type and shall be operated by an electric time clock control with a 7 or 14 day calendar time clock control capable of backwashing the filter at a preset time every day. It shall include a manual override to permit manual initiation of backwashing and then return to automatic operation. The length of each step of backwash shall also be field adjustable. The valve shall have a 120 volt single phase power requirement. The valve shall have a 1-year parts warranty and vendor shall provide 1 year of service warranty (labor).
- E. Provide granular media (Activated Carbon) made from selected grades of bituminous coal combined with suitable binders to give superior hardness and long life. It shall have an iodine number of at least 850 and a minimum abrasion number of 75. Particle retention shall be forty (40) micron or larger.
- F. Each unit shall have cubic feet of granular activated carbon, rated for a service flow rate of gpm at a pressure loss of less than 15 psi. Each unit shall have a minimum backwash flow rate of gpm.
- G. Acceptable manufacturers:
 - 1. Marlo,
 - 2. Watertech,
 - 3. Culligan,
 - 4. Rainsoft or Owner Approved Equivalent

2.5 WATER SOFTENERS

- A. Refer to Specification Section 22 30 00.

2.6 REVERSE OSMOSIS UNIT(S) - RO

- A. Each reverse osmosis unit shall be capable of providing [] gallons per day, of permeate water with a Total Dissolved Solids level of less than 15 ppm at 21 degrees C. This system shall be capable of being expanded to increase capacity by twenty-five percent without the need to replace installed tanks, filters or controls. The system shall operate at a 65% recovery rate.
- B. The reverse osmosis unit(s) shall contain thin film composite, spiral-wound membranes within FRP or stainless steel pressure vessels in a 2 x 1 x 1 x 1 brine staged array. Each vessel shall have a working pressure rating of 300 psig at 100 degrees F.
- C. The reverse osmosis unit(s) shall utilize a multi-stage centrifugal pump. The impellers and diffusers shall be constructed of 316 stainless steel. The pump shall boost the supply pressure by 200 PSI at design flow.
- D. A prefilter system with 5 micron pleated cartridge filters shall be included. Prefilter sizing shall be based on 1.0 gallon per minute per square foot of filter surface area. The filter housing shall be constructed of polypropylene.
- E. All low pressure piping shall be Schedule 80 PVC or specially qualified thermoplastic tubing. The high pressure piping shall be 316L stainless steel or special high pressure thermoplastic tubing. All welded pipe shall be passivated.
- F. All low pressure valves shall be PVC ball, ball check, or butterfly design. All high pressure (over 125 psi) valves shall be 316 stainless steel ball, butterfly, glove or needle valves. The system shall include a motorized inlet shut-off valve for systems isolation during shutdown. Cleaning valves and fittings shall be provided for membrane cleaning system connection.
- G. Glycerin filled pressure gauges shall be provided to measure filter pressure drops, pump discharge, membrane feed and reject. Process control gauges shall be panel mounted.
- H. Flow meters shall be used to indicate the flow of the reject and product water in order to monitor the unit operations. These meters shall be panel mounted.
- I. All process equipment shall be affixed to and mounted on a structural steel skid. All fasteners are composed of stainless steel or PVC. Skids shall be painted with two zinc enriched primer coats and two acrylic enamel finishing coats. Both membrane housings and pump shall be mounted vertically.

2.7 CONTROL PANEL

- A. A central control panel shall be a NEMA 4X enclosure complete with local visual and audible alarms for storage tank low water level (re-pressurization pump shutdown), ultraviolet lamp out, high tank level alarm, and low conductivity. Unit shall interface with tank level sensors.
- B. The control panel shall be PLC based and have a silencer switch, main disconnect switch, motor starters (VFD), step-down transformer, flow monitor, conductivity monitor

controller, re-pressurization pump controller and necessary motor starters. Control panel shall include interlocks for RO unit shutdown upon carbon filter backwash and ultraviolet light shutdown when both re-pressurization pumps are turned off.

- C. The control panel shall be provided with a single point electrical power connection for [115][460] volt, [single phase][three phase] service with gateway for full interface with Building Automation System (BAS) via BACnet IP communication, for the following:
1. Ultraviolet Light Alarm.
 2. RO Unit Failure Alarm.
 3. System Flow Indication.
 4. Re-Pressurization Pump Status/Failure Alarm.
 5. Conductivity Reading and Alarm.
 6. Storage Tank High/Low Level Alarm.

2.8 STORAGE TANK

- A. Tank shall be [] gallon vertical cylindrical type, made of low density polyethylene, with a non-vented manway located on the top. The tank shall be translucent with molded in calibrations, flat bottom and domed top. All tank connections shall be fused (bulk head connections are unacceptable). Polyethylene tanks shall be made of FDA approved resin. Provide a 10" HEPA filter made from PTFE rated at 0.2 microns, housed in a clear polycarbonate filter housing for the tank atmospheric vent. Provide tank openings as required for inlet, outlet, vent and level indications. The storage tank shall have a diameter of approximately [] feet and [] inches:

2.9 PRESSURIZATION PUMP (SYSTEM PUMP)

- A. The pumps shall have:
1. An integral variable speed drive, vertical multi-staged centrifugal, with TEFC motor.
 2. The shaft, impellers, diffuser chambers, EPDM O-rings, outer pump sleeve and suction interconnector shall be of 316 stainless steel with 150 pound R.F. ANSI flange inlet and outlet connections.
 3. The motors shall be [120 volt] [460 volt], [single phase][3 phase], 60 hertz, with NEMA frame size, 3450 RPM.
 4. Refer to Contract drawings for scheduled flow rate, head, and electrical requirements.
 - 5.
- B. Acceptable manufacturers:
1. Grundfos,
 2. Goulds,
 3. Armstrong or Owner Approved Equivalent.

2.10 ULTRAVIOLET STERILIZERS

- A. Provide ultraviolet sterilizers that shall be rated at a minimum of [] GPM with outlet and inlet stainless steel flanged connections. Lamps shall have manual wipers and use 115 VAC, 60 Hz power requirement. Pressure drop at maximum recommended flow must be 5 psi or less. The bulbs shall be 254 nanometers wave length type. The treatment chamber and all wetted parts shall be of 316 stainless steel. The sterilizers shall include elapsed running time meter and ultraviolet dosage monitor with alarms for low intensity light. The units shall be complete with on/off switch and monitor to indicate lamp out to system control panel. The equipment shall meet US Department of Health regulations.

- B. Acceptable manufacturer: Atlantic Ultraviolet, American Ultraviolet Company, Wedeco/Ideal Horizons or Owner approved equivalent.

2.11 FINAL FILTER

- A. Provide minimum of two round filter housings made from 316 stainless steel electropolished with replaceable FDA approved polypropylene filter cartridges with 222/fin configuration and Viton seals with a 0.2 absolute micron rating. Housing shall have a 180 grit electropolished finish and be rated at a working pressure of 150 psi. Filters shall be provided with elbow having 150 pound RF ANSI flange inlet and outlet connections. Filter assembly shall have a minimum gpm rating at a 5-psi pressure drop.
- B. Acceptable manufacturer: Shelco, Harmsco or Owner approved equivalent.

2.12 CONDUCTIVITY MONITOR

- A. The conductivity monitor shall be UL listed with an LCD display, push button operation with type 316 stainless steel sensor and step-down transformer, operating on 12-24 VAC power, interfaced with the system control panel. Unit shall alarm when conductivity drops below 10 micromhos.
- B. Acceptable manufacturers: HMI, GF Signet or Owner approved equivalent.

2.13 STORAGE TANK LEVEL SENSOR

- A. The storage tank level sensor shall be a pressure type sensor with a pressure range of 0-5 psig pressure range, with a maximum pressure of 10 psig, full scale accuracy of 0.25%, type 316L wetted materials, Nema 4X housing, 4-20 Ma output signal, 13 to 30 VDC power requirement, with conduit housing, with full compatibility to interface with system control panel. Manufactured by Dwyer or Owner approved equivalent.

2.14 FLOW METER

- A. Provide an in-line type 316 stainless steel turbine type flow meter, with a service flow rate range coordinated with the RO water system flow rate, accuracy of approximately 5%, 15 foot cable, with threaded ends
- B. Manufactured by Clack or Owner approved equivalent.

2.15 BACKPRESSURE REGULATING VALVE

- A. Provide pressure retaining valve capable of maintaining constant pressure on the RO piping system and the individual piping loops, with an adjustable pressure range of 7-150 psi, PVDF body, EPDM seals, PTFE/EPDM diaphragm, true union style,
- B. Manufactured by GF Type 586, or Owner approved equivalent.

2.16 PRESSURE GAUGES

- A. The pressure gauges shall be 2-1/2" single scale dial of 0-160 psi and stainless-steel case. The tube and socket material will be made from 316 SS. The gauges will be liquid filled with glycerin and have a lower connection size of 1/4-inch NPT. The gauges are to be mounted in an Ultrapure Gauge Guard.

- B. Manufactured by Plast-O-Matic or Owner approved equivalent.

2.17 PRESSURE REGULATING VALVES

- A. Provide pressure regulating valves where a specific pressure setting is required at the outlet side of the valve. The valve shall be adjustable capable of setting the downstream pressure to a specific pressure regardless of the upstream pressure. The valve shall have a pressure setting range of 7-130 psi, EPDM/PTFE diaphragm, EPDM seals, consisting of PVDF body, true union style, socket or IR ends.
- B. Manufactured by George Fischer Type 582, or approved equivalent by Plast-O-Matic or Asahi.

2.18 FLOW CONTROL VALVE

- A. Provide flow control valve directly upstream of RO water system outlets, such as at each faucet, to automatically maintain a set flow rate to that device regardless of inlet pressure ranges from 15 psi to 120 psi. The flow control device shall be factory set at ½ gpm, unless otherwise indicated on the Contract drawings. The valve shall have a PVDF body, EPDM seal, with a minimum pressure drop of 15 psi.
- B. Manufactured by Plast-O-Matic Series FC, or Owner approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.

3.2 PREPARATION

- A. Rough-in equipment piping connections in accordance with minimum sizes indicated in manufacturer's data.
- B. Important Safety Precautions: Prior to any operations, be sure that protective equipment and safety shower and/or hose stream is available for personnel protection. Follow chemical manufacturer's safety instructions. Tag all distribution valves with the following information: "DANGER-Men Working on Equipment-DO NOT TOUCH"

3.3 CLEANING AND DISINFECTION

- A. The entire RO water system shall be cleaned and disinfected after the installation is complete.
- B. A semi-conductor grade 35 percent unstabilized hydrogen peroxide diluted to 5 percent with deionized water shall be used as the disinfectant. Sodium hypochlorite is not acceptable.

- C. The Hydrogen peroxide disinfection solution shall be placed in storage tanks, pumped through 0.2 micron absolute membrane filters and into the piping system. All valves and sample ports shall be opened to purge distribution lines of gases and then closed.
- D. The hydrogen peroxide solution shall be circulated throughout the system for 4 hours. At the end of the 4 hour period, valves and sample ports shall be opened and system shall be drained.
- E. The entire system shall then be flushed with RO water until there is no disinfectant residual detected.
- F. After the system is certified clean, install new filters throughout in addition to the spare filters to be given to the Owner.
- G. At the completion of the disinfection process, the RO water system shall be put on-line with equipment ready for operation and distribution piping system in the circulation mode.
- H. The system shall be placed on-line by a qualified service technician with a minimum 5 years of experience with RO water system equipment.

3.4 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Covered under this Section of the specifications is the actual delivery of water treating equipment, installation materials and related supplies, unpacking of equipment, installing equipment, commissioning the system, instructing owner personnel as relates to operation and maintenance of the system.
- D. Electrical wiring between control panel and system related motors, level controllers, monitors, and all other RO water system equipment components shall be the responsibility of this Contractor. Coordinate electrical work with Division 26 electrical specifications.
- E. The equipment supplier/installer shall be responsible for delivery, unpacking and inspecting of all items relating to the water treating system. All equipment materials and supplies are to be new and, where practical, delivered to the job site in the manufacturers/suppliers shipping containers, with all items subject to inspection and acceptance by the General Contractor and Owners Representatives.
- F. The piping of the system from the inlet to the pre-filters of the system to the outlet of the system post-filters shall be the responsibility of the equipment supplier and must be performed by or supervised and directed by a Certified TCEQ Level 2 installer. The loop piping from the discharge side of the post filters and back to the equipment room shall be the responsibility of the project Plumbing Sub-Contractor.
- G. The Contractor is responsible for infrared welding machine and/or heat fusion machine required for installation of complete system.

- H. The piping and valves upstream of the RO unit shall be as specified for domestic cold water. Piping and valves from the outlet of the RO unit and throughout the system shall be the pipe material specified herein. Strictly follow pipe manufacturer's recommendations and guidelines for installation of piping system.
- I. Performance and Verification:
 - 1. The supplier/installer of the RO water production equipment shall be fully responsible for final checkout of the installed system, shall start the system into operation, and verify performance. All pieces of equipment shall be fully filled or loaded with consumables (salt, filter cartridges, batteries, bulbs, fuses, etc.).
 - 2. The supplier/installer of the water treating system shall verify the testing and monitoring that the system is reliably producing RO water at the outlet of the final filters.
 - 3. The equipment supplier/installer shall be responsible for follow-up responsibility of correcting any failure of the system caused by inferior equipment or workmanship for a period of one full year from successful start-up of the system when operated in accordance with instructions provided by the equipment supplier/installer.

3.5 START-UP AND SERVICE

- A. Make available the service of qualified personnel to supervise the installation and start-up of the entire system.
 - 1. Provide qualified personnel to train Owner maintenance and operations personnel in the maintenance and operation of the entire system.
 - 2. When start-up is complete, and the system is operational, notify Owner that the acceptance test will be started.
 - 3. Provide all chemicals, filters and expandable materials necessary to perform start-up service.
 - 4. Provide necessary chemical test kits as required by maintenance manuals in corrosion-resistant metal cabinet mounted on wall

3.6 TESTING

- A. Test the system under design operating conditions for a period of 24 hours and check for leaks. After all leaks have been repaired, retest the system until proven airtight.

3.7 CLEANING

- A. Clean plumbing trims and equipment.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of system before final acceptance.

END OF SECTION 24 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide all work for mechanical, electrical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, electrical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, electrical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with

mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all

finished areas.

1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7)

business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.

- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.

- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Baldor
 - 2. Marathon
 - 3. General Electric
 - 4. Weg
 - 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Service Factor: 1.15
 - 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEO.
 - 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Insulation System: NEMA Class F.
 - 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 - 7. Sound Power Levels: Conform to NEMA MG 1.
 - 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.

- F. Single Phase Motors:
1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.
 2. Service Factor: 1.35.
- G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

- A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:
1. Starters and motors specified as part of a packaged piece of equipment.
 2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
 3. Variable speed controllers for variable volume air handling units and cooling towers.
- B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.
- C. Provide a tabulation of matched motors and starters provided under Division 23.
- D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.
- E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2

15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7
40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment roof curbs and support rails.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel and angle.
9. Equipment bases and supports.
10. Portable roof pipe supports.

- B. Related Sections:

1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Pipe stands.
 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 1. Hangers and Supports: Submit special procedures and assembly of components.

- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems
 - 6. Carpenter & Patterson Inc.
 - 7. Anvil International
 - 8. Piping Technology & Products
 - 9. Grinnell
- B. Hydronic Piping:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
 5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
 6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
 7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 10. Vertical Support: galvanized Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 14. Copper Pipe Support: Copper-plated, carbon steel ring.
 15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

- A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.

- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Thunderline Link-Seal, Inc.
 2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Allied Tube & Conduit Corp.
 2. B-Line Systems
 3. Midland Ross Corporation, Electrical Products Division
 4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete
- B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
1. Hot Water Boilers: four (4) inches.
 2. Floor Mounted Pumps: four (4) inches.
 3. Floor Mounted Water Volume Tanks: four (4) inches.
 4. Air Handling Units: four (4) inches.
 5. Water Heaters: four (4) inches.
 6. Water Softeners: four (4) inches.
 7. Air Compressor: four (4) inches.
 8. Floor Mounted Expansion Tanks: four (4) inches.
 9. Floor Mounted chemical feeder tanks: four (4) inches.
 10. Floor Mounted Fans: four (4) inches.
 11. Chillers: four (4) inches.
 12. Condensing Units: four (4) inches.
 13. Heat Pump Units: four (4) inches.

14. Dust Collectors: four (4) inches.
 15. Plasma cutters: four (4) inches.
- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.11 PORTABLE ROOF PIPE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Advanced Support Products (ASP)
 2. PHP System Design
- B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model SS6000P with height adjustable crossbar and clevis hangers. Product specifications:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
 6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:
1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
 2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
 4. Height: Adjustable.
 5. Required accessories: Strut clamps and protection pads.
 6. Hot dipped galvanized threaded rods, nuts and washers.

- D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.
 - 1. Material: Porous rubber.
 - 2. Weight: 2 lbs.
 - 3. Dimensions: 18" square X ½" thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach

Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.

- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

F. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall and partition floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 1. Plastic Surfaces: Milcor Style K.
 2. Ceramic Tile Surface: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17" circular bases removing any loose gravel and foreign matter before setting 17" circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer's system under each 17" circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½".
- B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.
- D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
 - 8. Pipe painting (if required)
- B. Related Sections:
 - 1. Division 9 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.

- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Plastic Underground Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

4. Almetek Industries.
5. Marking Services, INC. (MSI).

B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

- A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Domestic Water	Green	Domestic Water

Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
 - 1. Engineered Air Balance
 - 2. Precision Air

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone

number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance."
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place or in normal position.
 - 15. Service and balancing valves are open.
 - 16. Re-sheave

- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 - 2. Air Outlets and Inlets: +/- 5%
 - 3. Heating-Water Flow Rate: +/- 5%
 - 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical 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 the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. 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 that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain 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. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
 1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
 1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 2. Verify sufficient inlet static pressure before making volume adjustments.
 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the

terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 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 of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.

- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 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 TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, 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. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, 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.

7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - 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, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow 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. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft

- h. Tube size in NPS (DN).
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm (L/s).
- b. Average face velocity in fpm (m/s).
- c. Air pressure drop in inches wg (Pa).
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
- e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
- f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
- g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
- h. Water flow rate in gpm (L/s).
- i. Water pressure differential in feet of head or psig (kPa).
- j. Entering-water temperature in deg F (deg C).
- k. Leaving-water temperature in deg F (deg C).
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig (kPa).
- n. Refrigerant suction temperature in deg F (deg C).
- o. Inlet steam pressure in psig (kPa).

G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h (kW).
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm (L/s).
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg (Pa).
- f. Leaving-air static pressure in inches wg (Pa).
- g. Air static-pressure differential in inches wg (Pa).
- h. Low-fire fuel input in Btu/h (kW).
- i. High-fire fuel input in Btu/h (kW).
- j. Manifold pressure in psig (kPa).

- k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

- g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - 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).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:

- a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- N. Vibration Test:
 1. Location of points:

- a. Fan bearing, drive end
- b. Fan bearing, opposite end
- c. Motor bearing, center (when applicable)
- d. Motor bearing, drive end
- e. Motor bearing, opposite end
- f. Casing (bottom or top)
- g. Casing (side)
- h. Duct after flexible connection (discharge)
- i. Duct after flexible connection (suction)

2. Test readings:

- a. Horizontal, velocity and displacement
- b. Vertical, velocity and displacement
- c. Axial, velocity and displacement
- d. Normally acceptable readings, velocity and acceleration
- e. Unusual conditions at time of test
- f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
- C.
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
 - 4. ASTM C1136: 150 degrees F.
 - 5. ASTM C1290.
 - 6. UL 181 for Class I Air Duct.
 - 7. NAIMA AHS-152T.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.
- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

- A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Owens Corning
 - 2. Johns Manville
 - 3. CertainTeed
 - 4. Knauf brand Insulation
- B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
- C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass
2. Alpha Glass
3. Childers
4. Vimasco

D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of the following:

1. 3M Fire Barrier Duct Wrap
2. Vesuvius Pyroscat Duct Wrap
3. Unifrax Corporation

2.2 DUCT WRAP

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: 8.3.
- D. Nominal Thickness: 3.0 inches.
- E. Installed Thickness: 2-1/4 inches.
- F. Installed Thermal Conductivity (compressed): $k = 0.27$
- G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- J. Testing Method 1338: Fungi Resistance Comply with requirements.
- K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.
- L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- A. Density: 1.5 pounds per cubic foot.
- B. Installed minimum R value: 6.3.
- C. Thickness: 1-1/2 inches.
- D. Thermal Conductivity k , (ASTM C518): 0.24
- E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies

(Hz)

Freq. (Hz)	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>NRC</u>
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85

- F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.
- G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.
- H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.
- J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.
- K. Bacteria Resistance (ASTM G22): Comply with requirements.
- L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 GREASE EXHAUST DUCT

- A. 1-1/2-inch-thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.
- B. Product to be UL Listed as a two (2) hour duct enclosure.
- C. Product shall be tested in accordance with the following:
 - 1. ASTM G 411
 - 2. ASTM C 51
 - 3. ASTM E 84
 - 4. ASTM E 119
 - 5. ASTM E 136
 - 6. ASTM E 814
 - 7. UL 1978 Sections 12 and B

2.5 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
 - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
 - 2. Size: At least three (3) inches wide.

- C. Mastic and Glass Fabric System:
 - a. Material Standard: Listed and labeled under UL 181A, Part III.
 - b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:
 - a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: 12 inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 18 inches on center.
 - b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: six (6) inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.
6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.

7. If the specification requires use of multiple insulation layers, take the following additional steps:
 - a. Affix bottom layer of duct liner in normal manner.
 - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
 - c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.
 - d. Use mechanical fasteners of the proper length for the double layer.
8. Application: Provide duct liner as follows:
 - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
 - b. Provide duct liner in all return air boots and transfer ducts.
 - c. Provide duct liner in the first 20 feet of supply and return duct from roof mounted air handling units / roof top units.

B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:

1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.
2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
3. To ensure installed thermal performance, duct wrap insulation shall be cut to "stretch-out" dimensions as shown in tables in manufacturer's literature.
4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.
6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.
9. Application: Provide duct wrap as follows:

- a. All supply duct
- b. All outside air supply and intake duct
- c. All return air duct
- d. All return air plenums on air units
- e. All intake plenums on outside air handling units
- f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. GREASE EXHAUST DUCT AND FITTINGS:

1. Provide one (1) or two (2) layers of Ductwrap to create a 2-hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2-inch x 0.015-inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2-inch hose clamps.
2. Access Door Installation: Four galvanized steel threaded rods, 1/4-inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.
3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2-inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.
4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of 10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.

5. Provide 12 ga copper-coated steel insulation pins with 1.5-inch square or round cup-head pins. Insulation pins are to be welded to ducts.
6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3-inch overlap.
7. Application:
 - a. Provide 2-hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

D. EXTERIOR OR INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 2", 2.0 pcf insulation on exterior duct (installed R-value of 8.0) and 1-1/2", 1.5 pcf (installed R-Value of 6.0) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
4. Application: Provide double wall duct as follows:
 - a. Gymnasiums
 - b. Natatoriums
 - c. Return air plenums with ducted connection to return grilles
 - d. Ducted connections to return air grilles
 - e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

- A. Supply and return ducts routed indoors (Ambient temperature $\leq$ 85 degrees Fahrenheit, RH $\leq$ 70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature $\leq$ 95 degrees

Fahrenheit, $RH \leq 70$ percent): R-8.3 (minimum).

- C. Supply, return, and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 08 00 - COMMISSIONING OF HVAC

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. It is the intent of this Section to provide requirements for commissioning of the mechanical systems, subsystems, and equipment. This Section supplements the general requirements specified in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS
 - 2. This project shall have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor shall be responsible for executing, is defined in Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
 - 3. The requirements of this Section shall apply to all Sections of Division 23.
 - 4. Refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for definitions and additional information.
 - 5. Section 23 05 93 Testing, Adjusting and Balancing of HVAC for TAB required responsibilities.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meetings.
- C. Attend testing, adjusting, and balancing review and coordination meetings.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least [10] days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- B. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- C. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- D. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

- E. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Heating and cooling piping:
 - 1. Control valves
 - 2. Flow meters
 - 3. Flow switches
 - 4. Press and temp sensor wells & sockets
 - 5. Temp sensor wells and sockets
- B. Duct accessories:
 - 1. Airflow stations
 - 2. BAS control dampers
 - 3. Terminal unit controls

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Communications with Third Party Equipment:
 - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:
 - a. Switchgear
 - b. Variable Speed Drives
 - c. Computer Room Units (MDF)
 - d. Rooftop Units
 - e. HVAC Fans

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. Division 01- General
 - 2. Division 23 – Mechanical
 - 3. Division 26 – Electrical

1.5 DESCRIPTION

- A. General: The control system shall consist of a complete BAS system with a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphics. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.
- B. If manufacture offers a web-based BAS platform, the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment.
- C. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.
- D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms specified shall be BACnet objects.

1.6 APPROVED CONTROL SYSTEMS

- A. The following are approved control system suppliers, manufacturers, and product lines:
 - 1. Schneider Electric (Basis of Design)

1.7 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
 - 1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).

2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
3. BAS Graphics shall be Three Dimensional Thermographic.
4. BAS provider shall warranty controllers for 1 years.
5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.8 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority's codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
 1. National Electric Code (NEC)
 2. International Energy Conservation Code (IECC)
 3. International Building Code (IBC)
 4. Uniform Mechanical Code (UMC)
 5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
 4. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.
9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±2°F
Ducted Air	±2°F
Outside Air	±2°F
Dew Point	±3°F
Water Temperature	±2°F
Delta-T	±0.25°F
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Humidity	±5% RH	

Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.10 SUBMITTALS

- A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2017 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware

- a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 1. Direct digital controllers (controller panels)
 2. Transducers and transmitters
 3. Sensors (include accuracy data)
 4. Actuators
 5. Valves
 6. Dampers
 7. Relays and switches
 8. Control panels
 9. Power supplies
 10. Batteries
 11. Operator interface equipment
 12. Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.

- d. Floor plan schematic diagrams indicating field sensor and controller locations.
 - e. Riser diagrams showing control network layout, communication protocol, and wire types.
- 2. Central System Hardware and Software
 - a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - 1. Central Processing Unit (CPU) or web server
 - 2. Monitors
 - 3. Keyboards
 - 4. Power supplies
 - 5. Battery backups
 - 6. Interface equipment between CPU or server and control panels
 - 7. Operating System software
 - 8. Operator interface software
 - 9. Color graphic software
 - 10. Third-party software
 - c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
 - d. Network riser diagrams of wiring between central control unit and control panels.
- 3. Controlled Systems
 - a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

- d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.
 - 4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).
- B. Schedules
 - 1. Within two months of contract award, provide schedule of work indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
 - 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
 - 1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2017 and 6 prints of each drawing on 8 1/2" x 11" paper.
 - 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).
 - 3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware;

how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

- f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
- g. Graphic files, programs, and database on magnetic or optical media.
- h. List of recommended spare parts with part numbers and suppliers.
- i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
- k. Licenses, guarantees, and warranty documents for equipment and systems.
- l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructors shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.

- 1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.
- 2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
- 3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.
- 4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.
- 5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.

6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.
7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.
8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.11 WARRANTY

A. Warrant work as follows:

1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **1 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally, contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.
2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.
3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.
4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
 - 5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.
- B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated

controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.
 - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 - 3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
 - 1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
 - 2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 - 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 - 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.
- C. Hardware. If providing a new server, each workstation or web server shall consist of the following:
 - 1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:
 - a. Dual Processor Intel Pentium 3.66 GHz processor
 - b. 1 GB RAM
 - c. 80 GB hard disk providing data at 100 MB/sec
 - d. RAID 5 Configuration
 - e. 128x CD-ROM drive
 - f. Most Current Windows Server Operating System
 - g. Serial, parallel, and network communication ports and cables required for proper system operation.
 - 2. If providing a server, the server shall support one or more the following database types:
 - a. SQL Server 2012 R2
 - b. PostgreSQL
 - c. MySQL
 - d. MS Access
- D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. Log In and Log Out. System shall require username and password to log in to operator interface.
 - 2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall
 - a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.

- d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
 3. System Configuration. Operators shall be able to configure the system.
 4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
 5. Security. System shall require a username and password to view, edit, add, or delete data.
 - a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
 6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
 7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level this information shall be archived at the central server or all BAS workstations.
12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 1. Alarm History.
 2. Trend Data. Operator shall be able to select trends to be logged.
 3. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common

algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.

16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.

1. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 2. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
19. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).
- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.

- I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.
- J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- L. Energy Calculations.
 - 1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
 - 3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.
- M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).
- B. BACnet.
 - 1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.
 - 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in

ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.

E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability.

1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory.
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.
 2. Frame. Damper frames shall 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
 3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.
 4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than (10 cfm per ft²) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).
 6. Sections. Damper sections shall not exceed 48 in. - 60 in. Each section shall have at least one damper actuator.
 7. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.
1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.
 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -lb torque capacity shall have a manual crank.
 6. Acceptable Manufacturers:
 - a. Belimo
- C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
2. Type. Provide two or three-way control valves for two-position or modulating service as shown.
3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 1. Two-way: 100% of total system (pump) head.
 2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 1. Two-position service: line size.
 2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
 3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
 4. Two-way and three-way modulating valve shall be one or two sizes smaller than the pipe size.
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 1. Water zone valves: normally closed.
 2. Heating coils in air handlers: normally closed.
 3. Chilled water control valves: normally open.
 4. Other applications: as scheduled or as required by sequences of operation.
 - f. Acceptable Valve and Actuator Manufacturers:
 1. Belimo
4. Steam Valves.

- a. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide minimum close-off pressure rating equal to 150% of operating (inlet) pressure.
- b. Ports. Valves providing modulating service shall have linear ports.
- c. Sizing.
 1. Two-position service: select pressure drop equal to 10%-20% of inlet psig.
 2. Modulating service at 100 kPa (15 psig) or less: select pressure drop equal to 80% of inlet psig.
 3. Modulating service at 101-350 kPa (16-50 psig): select pressure drop equal to 50% of inlet psig.
 4. Modulating service at over 350 kPa (50 psig): select pressure drop as scheduled on drawings.

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

- E. Temperature Sensors.
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
 2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross-section.
 3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
 4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type.
 5. Differential Sensors. Provide matched sensors for differential temperature measurement.
- F. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%-80%.
 2. Duct sensors shall have a sampling chamber.
 3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.
 4. Humidity sensors shall not drift more than 1% of full scale annually.
- G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.
- H. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- I. Override Timers.
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application.

Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.

1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.

2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.
- O. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- P. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.
- Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).
1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
 2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- S. Local Control Panels.
1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
 2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.

3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).
- C. Test and Balance.
 1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.

2. Train Test and Balance Contractor to use control system interface tools.
 3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
 4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- D. Life Safety.
1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.
 2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.
 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.
- E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
 2. Each supplier of a control's product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.
 3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.
- B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).
- C. Continually monitor field installation for code compliance and workmanship quality.
- D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

- A. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).
- B. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.
- C. A Conduit fill based on plenum 18-gauge 2 conductor:
 - 1. 1/2 inch - No more than 4 conductors.
 - 2. 3/4 inch - No more than 8 conductors.
 - 3. 1 inch - No more than 12 conductors.
- D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- E. All wires whether control network or device wire shall be marked with Brady-type markers.
- F. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- G. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.
- H. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- I. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.
- J. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- K. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

- L. Do not install wiring in raceway containing tubing.
- M. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.
- N. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run-in same conduit or support. All cabling shall be supported every 5'-0" from approved cabling support method. Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3-meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- O. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- P. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- R. Use color-coded conductors throughout.
- S. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- T. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- U. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- V. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- W. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.
- Y. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ² of coil area.

- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

- A. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
 - 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

4. Provide necessary mounting hardware and linkages for actuator installation.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Label identifiers shall match record documents.

3.13 PROGRAMMING

- A. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- B. All DDC programming shall be accomplished through graphical programming, line code is unacceptable
- C. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.
 1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
 2. System Programming. Provide system programming necessary for system operation.
- D. Operator Interface.
 1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.
 2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and

third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.

3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
 7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
 8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.

1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly, and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.
2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.
 - a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
 - b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 - c. Demonstrate compliance with sequences of operation through each operational mode.
 - d. Demonstrate complete operation of operator interface.
 - e. Demonstrate each of the following.
 - f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - h. Building fire alarm system interface.
 - i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).

3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
- B. Acceptance.
1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
 2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 23 09 23

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC SYSTEM

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

GENERAL:

The BAS contractor shall provide all points listed under "Equipment Control Points" as well as any points required to accomplish the sequences of operation listed below. Refer to Specification 23 09 23 for input/output device specifications. Refer to contract drawings for additional items that may not be included in this specification.

- Division 26 contractor shall supply dedicated 120 vac power to a junction box in each mechanical room for use by the BAS.
- Building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Single Duct Air Terminal Unit.
- No portion of the total contract will be declared substantially complete until the automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point. Provide 15 day notice prior to demonstration.

1. SINGLE ZONE VAV PACKAGED ROOFTOP UNIT WITH ELECTRIC HEAT (BACnet INTERFACE)

All controls devices external to units shall be provided and installed by the control's contractor

Each rooftop unit shall have a factory furnished sequencing panel with BACnet interface. The BAS contractor shall provide and install wiring to the BACnet interface and provide programming to monitor the system. The BAS shall monitor or control all points listed in "Equipment Control Points" and any additional points required to accomplish sequences of operation. Mechanical contractor to coordinate start-up of BACnet interface with rooftop unit manufacture representative and BAS subcontractor. Verify the sequence of operations matches and is performed by the factory furnished controller and programming as specified.

Equipment Control Points

Supply air temperature – AI
Supply air temperature setpoint – AI
Discharge supply air temperature – AI
Space humidity – AI
Space humidity setpoint – AI
RTU fan status – current switch - DI
DX Cooling – DO (each stage)
Electric Heat - DO (each stage)
RTU fan start/stop - DO
Outside air damper/Exhaust fan start/stop – DO

Zone Occupancy

The BAS will have an occupancy/vacancy schedule (adjustable via BAS front end), occupied heating/cooling set points and unoccupied heating/cooling set points assigned to it (adjustable via BAS front end). As the occupancy time approaches, an optimum start/stop program will calculate a start time based on current space temperature verses the occupied heating or cooling set point, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the

central site. The BAS program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Unit Control

When the calculated start time arrives, the B.A.S. will send a signal to the RTU controller to enable the unit. A fan airflow proving switch will prove status to the RTU controller and will alarm at the central site if the switch is not made within 60 seconds (operator adjustable). There will also be a 60 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

Single Zone Variable Air Volume Space Temperature Control

This controls sequence modulates the supply fan VFD to maintain the space temperature setpoint while heating or cooling capacity is modulated to maintain the supply air temperature setpoint.

A wall mounted space temperature sensor shall monitor the air temperature in the space. The space temperature sensor determines the heating or cooling mode of operation.

In the cooling mode, the multi-stage scroll compressors will modulate to maintain the Cooling Leaving Air Setpoint. The supply fan VFD will begin operation at 30% and modulate between 30% and 100% as needed to maintain the space temperature within the Space Cooling Reset Window created by configuring a Space Cooling High and a Space Cooling Low Reset Source Setpoint.

In the heating mode the SCR electric heater will modulate to maintain the Heating Leaving Air Setpoint. The supply fan VFD will begin operation at 50% and modulate between 50% and 100% as needed to maintain the space temperature within the Space Heating Reset Window created by configuring a Space Heating High and a Space Heating Low Reset Source Setpoint.

When the space temperature setpoint has been satisfied, the unit will operate in ventilation mode and the supply fan will operate at 30%.

Equipment off Conditions

When the RTU is de-energized, the supply fan shall de-energize and the OA damper shall be fully closed.

Economizer Operation

The economizer acts as the first stage of cooling and controls to the active supply air cooling setpoint. If the economizer reaches 100% open (adj.) and the supply air temperature is still above setpoint, mechanical cooling is allowed to stage and modulate while the economizer is held at the full open position.

The economizer dampers shall fully modulate the OA damper from the minimum position to 100% open and shall use the integral barometric relief damper to relieve excess building pressure.

The BAS shall monitor outside and return air temperature and enthalpy.

The economizer shall be enabled whenever:

- Outside air enthalpy is lower than the return air enthalpy.
- The outside air temperature is 5°F less than the return air temperature.
- The supply fan status is on.

The economizer shall be disabled whenever:

- Outside air temperature rises 1°F above the economizer enable setpoint.

2. VARIABLE AIR VOLUME OUTSIDE AIR HANDLING UNIT WITH DCV (BACnet INTERFACE)

Equipment Control Points

Supply air temperature - AI
Pre-heat air temperature – AI
Duct Static Pressure – AI
Outside air flow – AI
Exhaust air flow - AI
CO2 Sensors – AI (refer to plans for quantity and locations)
Supply fan status – current switch – DI
Exhaust fan status – current switch – DI
Static pressure high limit switch – DI
Freeze alarm – freeze stat mounted upstream of coil – DI
Supply Fan start/stop – DO
Exhaust fan start/stop – DO
Supply fan speed control – AO
Exhaust fan speed control – AO
Electric Heat - DO (each stage)
Outdoor air damper – AO
RA damper – AO
Exhaust damper - AO

Unit Activation

When the outdoor air handling unit is requested to run by an air handler it serves, the Building Automation System (B.A.S.) shall first open the outdoor air damper and the actuator's internal end switch will close when the damper is open allowing the outdoor air unit to be started. The B.A.S. shall send a signal to the outdoor air handling unit inverter, which will start the fan. A current switch shall prove status to the B.A.S. and shall alarm at the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. The outdoor air damper shall be fully open before the outdoor air handling unit fan can be energized in either the hand or auto position.

Fan Control

When the air handler is requested to run, the B.A.S. control module will send signal to the air handler inverter, which will energize the fan. A current switch will prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request will be sent to the air-handling unit is active and cooling is required.

Temperature Control

When outdoor air handling unit is active, and heating is required a duct temperature sensor mounted downstream of the pre-heat coil will modulate pre-heat valve to maintain the operator adjustable pre-heat discharge air temperature set point of 55°F (adjustable). If cooling is required a duct temperature sensor mounted in the unit's supply air stream shall monitor the unit's supply air temperature and modulate to maintain the operator adjustable discharge air temperature set point. The operator shall be able to select if the supply air cooling set point shall be reset based on the outside air temperature or use an operator adjustable set point of 55°F. The outside air temperature reset schedule shall be a linear reset schedule with initial setpoints of 58°F supply air at 60°F outside air temperature and 55°F supply air at 75°F. The pre-heat control shall be disabled if the outside air temperature is greater than 55°F and the supply air cooling control shall be disabled if the outside air temperature is less than 53°F. All of the values shall be operator adjustable.

A manual reset freeze stat mounted in the discharge air stream of the pre-heating coil. If the freeze stat trips the BAS shall close the outdoor air damper, de-energize the outdoor air unit fan, and alarm

at the central site if the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Air Volume Control

While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

Air Volume Demand Control Ventilation

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled. A CO2 sensor mounted in the return air or in the space, or as indicated on drawings, shall monitor the CO2 level. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO2 level between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined by the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM. The B.A.S. shall select the highest level when more than one CO2 sensor is used to modulate the damper. The system shall have the ability to perform a "Purge Mode" at a scheduled time for a scheduled duration. The outside air damper shall remain closed even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

The BAS shall monitor the airflow in the outside air intake duct and the exhaust duct. The BAS shall modulate the speed of the exhaust blower to maintain a constant CFM differential between exhaust and outside air and prevent a negative building pressure. The TAB contractor shall determine the final setpoint.

Associated Equipment

During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed & exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Equipment off Conditions

When the RTU is de-energized, the supply fan shall de-energize and the OA damper shall be fully closed.

3. SINGLE ZONE VAV PACKAGED RTU WITH HUMIDITY CONTROL (BACnet INTERFACE)

All controls devices external to units shall be provided and installed by the control's contractor

The Rooftop units shall have a factory furnished controller with BACnet card. The BAS contractor shall furnish and install remote sensors and shall provide and install a BACnet interface and wiring. The BAS contractor shall coordinate with the unit manufacturer to ensure device compatibility with factory controller and sequences of operation meet specifications and to also discover and incorporate all available control points. RTU manufacturer shall verify software provided with the factory controller matches sequences of operation. The RTU manufacturer and the BAS contractor shall both commission the unit and verify operation. RTU shall be able to have all equipment control points available via BAS and **shall have read and write capability**.

Equipment Control Points

Space Temperature – AI (BACnet via BAS, installed by BAS contractor)
Space Humidity – AI (BACnet via BAS, installed by BAS contractor)
Occupied Cooling & Heating Space Temperature Setpoints – (2) AO (BACnet via BAS)
Unoccupied Cooling & Heating Space Temperature Setpoints – (2) AO (BACnet via BAS)
Cooling Low & High Reset Sources – (4) AO (BACnet via BAS)
Supply Air Temperature – AI (BACnet via BAS, installed by BAS contractor)
Supply Air Temperature Setpoint – AO (BACnet via BAS)
Electric Heat (SCR Control) – AO (BACnet via BAS)
Electric Heat Capacity – AI (BACnet via BAS)
Static pressure high limit – DI (Furnished and installed by BAS contractor)
RTU Alarm Status – DI (BACnet via BAS)
RTU fan status – current switch – DI (BACnet via BAS)
DX Cooling percent capacity – AI (BACnet via BAS)
Hot Gas Reheat Capacity – AI (BACnet via BAS)
Return air Relative humidity – AI (BACnet via BAS)
RTU start/stop – DO (Hardwired to BAS)
Variable Frequency Drive Position – AI (BACnet via BAS)
Variable Frequency Drive Override – AO (BACnet via BAS)
Economizer Position Override – AO (BACnet via BAS)
HVAC Mode Override – AO (BACnet via BAS)
HVAC Mode Status – AI (BACnet via BAS)
Individual Compressor Status – DI (BACnet via BAS)
Individual Digital Compressor Status – AI (BACnet via BAS)
Compressor(s) head pressure – AI (BACnet via BAS)
Compressor(s) discharge temp – AI (BACnet via BAS)
Air Flow Measuring Station – AI (BACnet via BAS)

Zone Occupancy

The BAS will have an occupancy/vacancy schedule (adjustable via BAS front end), occupied heating/cooling set points and unoccupied heating/cooling set points assigned to it (adjustable via BAS front end). As the occupancy time approaches, an optimum start/stop program will calculate a start time based on current space temperature verses the occupied heating or cooling set point, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The BAS program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Unit Control

When the calculated start time arrives, the B.A.S. will send a signal to the RTU controller to enable the unit. A fan airflow proving switch will prove status to the RTU controller and will alarm at the central site if the switch is not made within 60 seconds (operator adjustable). There will also be a 60 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

Single Zone Variable Air Volume Space Temperature Control

This controls sequence modulates the supply fan VFD to maintain the space temperature setpoint while heating or cooling capacity is modulated to maintain the supply air temperature setpoint.

A wall mounted space temperature sensor shall monitor the air temperature in the space. The space temperature sensor determines the heating or cooling mode of operation.

In the cooling mode, the digital scroll compressors will modulate to maintain the Cooling Leaving Air Setpoint. The supply fan VFD will begin operation at 30% and modulate between 30% and 100% as needed to maintain the space temperature within the Space Cooling Reset Window created by configuring a Space Cooling High and a Space Cooling Low Reset Source Setpoint.

When the space temperature setpoint has been satisfied, the unit will operate in ventilation mode and the supply fan will operate at 30%.

In the heating mode, the heating shall be modulated to maintain the heating setpoint. The supply fan VFD will begin operation at 50% and modulate between 50% and 100% as needed to maintain the space temperature within the Space Heating Reset Window created by configuring a Space Heating High and Space Heating Low Reset Source Setpoint.

When the space temperature setpoint has been satisfied, the unit will operate in ventilation mode and the supply fan will operate at 30%.

Economizer Operation

The economizer acts as the first stage of cooling and controls to the active supply air cooling setpoint. If the economizer reaches 100% open (adj.) and the supply air temperature is still above setpoint, mechanical cooling is allowed to stage and modulate while the economizer is held at the full open position.

The economizer dampers shall fully modulate the OA damper from the minimum position to 100% open and shall use the integral barometric relief damper to relieve excess building pressure.

The BAS shall monitor outside and return air temperature and enthalpy.

The economizer shall be enabled whenever:

- Outside air enthalpy is lower than the return air enthalpy.
- The outside air temperature is 5°F less than the return air temperature.
- The supply fan status is on.

The economizer shall be disabled whenever:

- Outside air temperature rises 1°F above the economizer enable setpoint.

Space Humidity Control

A humidity sensor shall monitor the humidity in the space. When humidity is above setpoint, the refrigeration capacity shall modulate to maintain the evaporator coil temperature setpoint of 50°F (adj.), and the hot gas reheat valve shall be modulated to maintain the cooling and heating setpoint.

Unoccupied Control

If the space temperature reaches the operator adjustable unoccupied set points of 55°F heating and 95°F cooling, the required equipment will be started and run to maintain the space temperature within the set points.

Equipment off Conditions

When the RTU is de-energized, the supply fan shall de-energize and the OA damper shall be fully closed. In the event of a power loss or system reset the OA damper shall close.

4. AIR TERMINAL UNIT WITH ELECTRIC HEAT

Equipment Control Points

Space temperature sensor – AI
Cold deck flow – AI
Discharge air temperature - AI
Infrared Occupancy Sensor Status - DI
Cooling damper - FM
Electric Heat (SCR Control) – AO

Zone Occupancy

Each VAV shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outdoor air temperature -- all variables are operator assignable from the central site. The VAV control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Occupied/Vacancy

Each terminal unit will monitor the status input on the infrared occupancy sensor in the classrooms. The sensors shall be provided with a single pull double throw contact closure for use by the BAS. During an occupied state if the local occupancy sensor detects an unoccupied room the BAS will enter the occupied vacant state. In this mode of operation, the zone setpoints will be adjusted outward by 3°F (adjustable) heating and 3°F (adjustable) cooling.

Temperature Control

When the zone becomes active, the VAV controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and a run request shall be sent to the air handling unit serving the VAV. As the space temperature returns to setpoint, the VAV cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint (initially set to 30% of maximum). If heating is required, the cooling air damper shall remain at its operator adjustable minimum CFM setpoint and the reheat valve shall be modulated to maintain the heating setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the VVB graphic and collected by the air-handling unit serving the VVB to reset the air handling unit static pressure setpoint.

During the unoccupied time period, the VAV cooling damper shall be closed (adjustable). If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

5. SERIES FAN POWERED AIR TERMINAL UNIT WITH ELECTRIC HEAT

Equipment Control Points

Space temperature sensor – AI
Discharge air temperature - AI
Cold deck flow – AI
Fan Start/stop – DO
Fan Status - DI
Cooling damper – FM
Electric Heat (SCR Control) – AO
Infrared Occupancy Sensor Status - DI

Zone Occupancy

The parent RTU shall have an occupancy schedule assigned to it. Upon occupancy the RTU shall broadcast an occupancy signal to the terminal unit,

When the CVB Boxes calculated start, time arrives its internal fan motor shall be energized and continue to run until the unoccupied period arrives.

Temperature Control

When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and cool request shall be

sent to the air handling unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the CVB graphic and collected by the air-handling unit serving the CVB to reset the air handling unit static pressure setpoint.

During heating mode, the CVB terminal damper will be maintained at its adjustable minimum heating CFM setpoint, and the heating element shall maintain the space temperature.

Unoccupied Control

During the unoccupied time period, the CVB cooling damper shall be open (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

6. COOLING ONLY VAV TERMINAL UNITS

Equipment Control Points

Space temperature sensor – AI
Discharge temperature - AI
Cold deck flow - AI
Cooling damper - FM

Zone Occupancy

Each VAV shall have cooling setpoints assigned to it. As the operating time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied cooling setpoint, assigned recovery rate, and outdoor air temperature -- all variables are operator assignable from the central site. The VAV control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Temperature Control

When the zone becomes active, the VAV controller shall determine based on the space temperature, if cooling is required. If cooling is required, the cooling air damper shall be modulated open to its maximum cooling CFM setpoint (adjustable) and a run request shall be sent to the air handling unit serving the VAV. As the space temperature returns to setpoint, the VAV cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint (30% of maximum).

Unoccupied Control

During the unoccupied time period, VAV cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint (30% of maximum). If the space temperature reaches the operator adjustable setpoint for cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

7. DUCTLESS MINI-SPLIT A/C UNITS

Equipment Control Points

Room temperature - AI
Unit alarm - DI

A split-system cooling unit coil shall be controlled by a microprocessor temperature sensor/controller, furnished by the unit manufacturer. The controller shall monitor the air temperature in the space. The thermostat shall energize cooling to maintain room setpoint. The BAS shall monitor the room temperature and alarm at the central site if the temperature rises above 85°F (adjustable).

8. TWO-SPEED EXHAUST FANS – SCIENCE LAB PURGE

Equipment Control Points

Purge Buttons – DI
Fan Status – DI
Fan Start/Stop – DO
Damper – DO

The fan shall be activated by a mushroom style momentary pushbutton, provided by the control's contractor. Pushbutton location shall be verified with owner and architect prior to installation. When the pushbutton is pressed, the fan shall be activated for 15 minutes (adjustable). Pressing and holding the pushbutton for 5 seconds (adjustable), shall cancel the purge sequence.

Unoccupied Control

During the unoccupied time period, the exhaust dampers will be closed (adjustable), and the exhaust fans will be off

9. LAB FUME HOOD VALVE EXHAUST SYSTEM

Equipment Control Points

High plume exhaust fan status – Current switch - DI
High plume exhaust fan start/stop – DO
Fume hood toggle / sash position - DI
Supply Air valve damper – floating motor
Lab exhaust fan speed – AO
Exhaust flow – AI (via velocity sensor)
Lab exhaust duct differential pressure – AI
Lab exhaust duct velocity – AI (via velocity sensor)

Supply Air Valve (SAV) System

The fume hood exhaust system will become active with the fume hood activation. When the system is activated, a run signal will be sent to the associated lab exhaust fan's (LEF) variable speed drive, which will start the fan. The BAS control module will receive an input from the LEF and will modulate its internal bypass plenum damper to control at setpoint.

Supply Air Valves (SAV) that serve the fume hoods shall be energized when the local hood LEF variable speed drive (VFD) is engaged. The controller shall modulate the associated SAV unit to maintain the scheduled airflow for the fume hood.

10. GENERAL LAB EXHAUST - EXHAUST FAN

Equipment Control Points

Exhaust fan status – Current switch - DI
Exhaust fan enable – DO

Each fume hood exhaust fan shall be controlled by a switch located on or near its respective fume hood. BAS shall monitor fan status.

11. INTERIOR / EXTERIOR LIGHTING CONTROL

Equipment Control Points

Lighting contactor enable/disable - DO
Lighting controllers

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

Provide integration to lighting control system. Provide graphics to show system status of lights and occupancy sensors.

Override

Provide a method of manual override in an easily accessible location (i.e., control relay with integral hand-off-auto in control panel).

12. LIGHTING TLO

Equipment Control Points

Override button input – DI

A local override button located as directed by owner shall allow temporary override of the interior lighting. Each press of the button shall override the system for 30 minutes (adjustable), to a maximum of 90 minutes (adjustable).

13. VARIABLE SPEED DRIVES INTERFACE

Equipment Control Points

Start/stop – DO

Alarm – DI

Last fault – AI

Reset – DO

% output – AI

Frequency output – AI

Speed – AI

Current – AI

Power – AI

Drive temperature – AI

KWh – AI

Runtime - AI

The BAS shall interface directly to each variable speed drive and report all information to the central site.

14. FREEZER/COOLER TEMPERATURE MONITORING AND ALARM

Equipment Control Points

Cooler temperatures – AI

Freezer temperatures – AI

The BAS contractor shall provide temperature sensors in the freezers and coolers. The BAS shall monitor the freezer and cooler temperatures and indicate the temperatures at the operator station. The BAS shall initiate an alarm if temperature rises above design and be sent to the computers,

paggers, text message / compatible cell phone designated by Katy ISD personnel. The BAS contractor shall set up trending information and reports per district standard. Coordinate with freezer/cooler manufacturer.

15. OUTSIDE AIR CONDITIONS

Equipment Control Points

Outdoor air temperature – AI
Outdoor air humidity – AI

The sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

16. BUILDING RELIEF HOODS

Equipment Control Points

Isolation Damper OPEN/ CLOSE – DO
Damper Position Status - DI

The BAS shall OPEN each motorized relief damper when the associated area is occupied. An internal Barometric damper shall OPEN/ CLOSE according to interior building air pressure.

In the event of a Shelter in Place shutdown all motorized Relief dampers shall be CLOSED.

17. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

18. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

19. HVAC TIMED LOCAL OVERRIDE (TLO)

Equipment Control Points

TLO momentary input – DI

A momentary push button switch shall be located in the principal's office and shall activate the HVAC system (user defined equipment). Each time the momentary button is pushed the assigned equipment will be energized for one hour (adjustable), up to a maximum of four hours (adjustable). If the switch is pushed continuously for seven seconds (adjustable), the override will be cancelled.

20. POWER MONITORING

Equipment Control Points

KW input – Current switch - DI

The BAS shall monitor the building power usage. The BAS control module shall integrate the input and calculate the buildings kWh usage. System graphic shall display the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust setpoints and shed loads in order to reduce peak consumption. All power usage data shall be available in an electronic format that is easily transferrable to the district's energy reporting software.

21. GENERAL EXHAUST

Equipment Control Points

Exhaust fan status – Current switch - DI

Exhaust fan enable – DO

Interlock all general exhaust fans to run with air handling equipment serving the same area and run only during the occupied mode with their OA Dampers open. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule. Where exhaust fans have associated motorized dampers, BAS contractor shall provide damper, actuator, and necessary interlock wiring to allow damper to open whenever the exhaust fan is running.

22. WELDING EXHAUST FANS

Equipment Control Points

Fan status (each fan) – Current switch – DI

A wall mounted switch shall energize the local exhaust fans. The BAS shall monitor the status of each fan via current switch.

23. PLASMA CUTTER EXHAUST FAN

Equipment Control Points

Fan status (each fan) – Current switch – DI

A wall mounted switch shall energize the local exhaust fan. The BAS shall monitor the status of each fan via current switch.

24. FABRICATION SHOP (156) OVERHEAD DOOR INTERLOCK

Equipment Control Points

Door limit switch – DI

The BAS contractor shall provide a limit switch mounted to detect the position of the overhead rollup door. The limit switch shall be wired to the VAV-1-36 and VAV-1-37 controller and when activated the BAS program shall disable the VAV units. When overhead head roll up door have been closed a 5-minute time delay (adjustable) will prevent short cycling to turn ON the associated VAV units (RTU-36).

25. KITCHEN HOOD EXHAUST FANS / MAKE-UP AIR UNIT

Equipment Control Points

Exhaust/Supply fan status (each fan) - Current switch – DI
Exhaust/Supply fan enable – DO
Supply Air Temperature – AI
Electric heater – DO

The heater in the makeup air unit shall modulate its heating to maintain a supply air temperature of 75°F (adjustable). The heater shall be locked out if the outside air temperature is greater than 75°F (adjustable).

The kitchen hood supply MAU and exhaust fans shall be interlocked to operate together. The hood fans shall be enabled to run by the BAS based on an operator assigned schedule. When the fans are enabled to run they shall be controlled via a local switch mounted at the hood.

The fans shall remain off even during the scheduled operating time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

26. KITCHEN HOOD EXHAUST / SUPPLY FANS

Equipment Control Points

Exhaust / Supply fan status (each fan) - Current switch - DI
Exhaust / Supply fan enable – DO
Supply Air Temperature – AI
Electric Heat - DO

The kitchen hood supply and exhaust fans shall be interlocked to operate together. The hood fans shall be enabled to run by the BAS based on an operator assigned schedule. When the fans are enabled to run, they shall be controlled via a local switch mounted at the hood.

The fans shall remain off even during the scheduled operating time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

27. DISHWASH HOOD EXHAUST FAN

Equipment Control Points

Exhaust fan status – Current switch – DI
Exhaust fan enable – DO

The fan shall be enabled to run by the B.A.S. based on an operator assigned schedule. When the fan is enabled to run it shall be controlled via a local contact in the dishwasher through a delay on break time delay relay which shall continue to run the fan for ten (10) minutes (adjustable at the time delay relay) after the dishwasher is off. The fan shall remain off even during a scheduled operating time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

28. CHEMICAL STORAGE ROOM EXHAUST FAN

Equipment Control Points:

Fan status - DI

The fans shall be wired to operate continuously. The BAS shall monitor status via current sensing relay. If fan stops, as sensed by current switch, the BAS shall alarm the operator.

29. ELECTRIC UNIT HEATERS

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

30. BUILDING SHUTDOWN (SHELTER IN PLACE)

Equipment Control Points

Shutdown switch status – dry contact - DI

Provide a single mushroom style pushbutton adjacent to fire alarm control panel. Operation shall be pushbutton off, keyed switch on. Provide clear plastic cover to prevent accidental activation. Provide engraved identification tag with "Emergency HVAC Shutdown". When activated, the BAS shall shut down the HVAC system and close all intake, exhaust and relief dampers. The button must be manually reset (via key) to allow the HVAC system to resume normal operation. Confirm location with owner/architect prior to installation.

31. POWER MONITORING

Equipment Control Points

KW input – Current switch - DI

The BAS shall monitor the building power usage. The BAS control module shall integrate the input and calculate the buildings kWh usage. System graphic shall display the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust setpoints and shed loads in order to reduce peak consumption. All power usage data shall be available in an electronic format that is easily transferrable to the district's energy reporting software.

32. ELECTRIC DRINKING FOUNTAIN

Equipment Control Points

Electric Drinking fountain enable/disable – 24 VAC relay (re: electrical plans)

The BAS shall control contactors provided and installed by Division 26 contractor for control of electric drinking fountains. The BAS shall provide scheduling of drinking fountains. Coordinate with contactor schedule on electrical drawings.

33. MISCELLANEOUS METERING

Water Metering

The main water meter entering the building shall be monitored for usage. The BAS shall record historical data to include current gallons, gallons today, previous day, for the month and previous month, the year and previous year. Landscaping contractor to provide a PVC conduit with pull-string from the building to the domestic water meter location.

Water Softener

The BAS shall monitor the water softener for an alarm. The softener shall have a dry contact closure to provide to the BAS. The alarm shall be displayed back to the central site.

END OF SECTION 23 09 93

SECTION 23 31 13 - METAL DUCTS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and Flat Oval ducts and fittings.
 - 3. Double-wall rectangular ducts and fittings.
 - 4. Double-wall round and Flat Oval ducts and fittings.
 - 5. Insulated Flexible Ducts
 - 6. Sheet metal materials.
 - 7. Sealants and gaskets.
 - 8. Duct coating requirement for Natatoriums.
 - 9. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 3. Division 23 Section 23 07 13 "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. $\frac{1}{4}" = 1'-0"$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Sheet Metal Connectors, Inc
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- C. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support

intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Material:
1. Outer Duct: 18-gauge epoxy coated galvanized duct.
 2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- C. Inner Duct: 20 gauge perforated galvanized duct.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
- E. Exterior Coating / Finish.
1. Epoxy coated exterior duct.
 2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
 3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Thermaflex Type M-KE.
 - b. Atco

- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
- a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 5'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
- 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
- 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent,

or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.
- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16-gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
4. Ducts Connected to Dishwasher Hoods:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
5. Ducts Connected to Shower Return air grilles:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
6. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 1. Exposed to View: No. 4 finish.
 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.

- e. SMACNA Leakage Class: 3.
7. Ducts Connected to Chlorine and Acid Rooms (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
8. Ducts Connected to Fans Exhausting Welding Fumes (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
- E. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 - 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- F. Elbow Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1. Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.
 - b. Velocity 1,000 to 1,500 fpm: Conical tap.
 - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Back-draft dampers.
 - 2. Combination fire-and-smoke dampers.
 - 3. Duct access doors.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Volume control dampers.
 - 7. Flexible duct connections
 - 8. Duct Taps
 - 9. Duct test holes
 - 10. Flexible duct elbow supports
- B. Related Sections:
 - 1. Section 23 31 13 – Metal Ducts: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.

- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco

2. NCA
 3. Ruskin
 4. Nailor
 5. Pottorff
 6. Greenheck
- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Cesco
 2. NCA
 3. Ruskin
 4. Nailor
 5. Pottorff
 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
 - 2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 - 3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12".
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
 - 1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 - 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 - 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 - 2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 - 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
 - 1. Maximum damper area per actuator shall be 24 square feet face area.

2. Actuators shall be two position or modulating spring return type.
3. Duct mounted dampers shall have actuators mounted outside of air stream.
4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 2. Net Fabric Width: Approximately six (6) inches wide.
 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

- A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.
- B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.
- C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.
- D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.

- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.
- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Install stainless steel volume dampers in stainless steel ducts.
 - 4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Hooded propeller roof fans
 - 2. Upblast centrifugal roof fans
 - 3. Downblast centrifugal roof fans
 - 4. Upblast centrifugal roof fans – Grease exhaust
 - 5. Centrifugal filtered supply fans
 - 6. Inline Fans
 - 7. Side Wall Propeller Fans
 - 8. Utility Vent Set
 - 9. High Volume, Low Speed Fans
- C. Related Sections:
 - 1. Section 23 31 13 - Metal Ducts - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: Two (2) sets for each belt-driven fan.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14 gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18 gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7 gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: 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 sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, 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. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent 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.

- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.3 DOWNBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Fan shall be a spun aluminum, roof mounted, belt driven, and downblast centrifugal ventilator.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: 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 sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of

tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, 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. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent 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.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.4 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.

- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14 gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three pound density foil back heat shield shall be utilized to protect the motor and drive components from excessive heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Belts and Dives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26.
 - 2. Direct drive units shall be provided with motor speed control option.
 - 3. Gravity actuated back-draft damper with adjustable counter weight.
 - 4. Provide minimum 10" tall vented curb extension.
 - 5. Provide grease trap with drain connection.
 - 6. Provide heat baffle.
 - 7. Provide Clean-Out Port.

2.5 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry

- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel, bolted to a minimum 16 gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.6 INLINE FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.

3. Loren Cook Company
 4. PennBarry
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
 2. Gravity actuated back-draft damper with adjustable counter weight.
 3. Direct drive units shall be provided with motor speed control option.
 4. Companion Flanges: For inlet and outlet duct connections.
 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.7 SIDE WALL PROPELLER FANS

- A. Manufacturers:

1. Acme Engineering and Manufacturing Corp.
 2. Greenheck Corp.
 3. Loren Cook Company
 4. PennBarry
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, fabricated steel, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Drive:
1. Resiliently mounted to housing.
 2. Statically and dynamically balanced.
 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 4. Extend grease fitting to accessible location outside of unit.
 5. Service Factor Based on Fan Motor Size: 1.4.
 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 8. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
 9. Pulleys: Cast iron with split tapered bushing; dynamically balanced at factory.
 10. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 11. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
 12. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
1. Long wall housing, flush exterior with OSHA guard.
 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weather shield Hood: Galvanized steel to match fan and accessory size with bird screen.
5. Weather shield Front Guard: Galvanized steel with expanded metal screen.
6. Direct drive units shall be provided with motor speed control option.
7. Provide factory damper mounted with damper actuator. Actuator shall be same voltage as the motor in the fan. Damper shall energize the fan through an integral end switch.
8. Disconnect Switch: factory provided and wired disconnect switch on 120 volt motors only; Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.8 UTILITY VENT SET FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Engineering and Manufacturing Corp.
 2. Greenheck Corp.
 3. Loren Cook Company
 4. PennBarry
- B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
 1. Blade Materials: Steel.
 2. Blade Type: Backward inclined.
- D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L50 of 200,000 hours.
 1. Extend grease fitting to accessible location outside of unit.
- F. Belt Drives:
 1. Factory mounted, with final alignment and belt adjustment made after installation.
 2. Service Factor Based on Fan Motor Size: 1.5.
 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

4. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- a. Accessories:
 1. Inlet and Outlet: Flanged.
 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
 4. Access Door: Gasketed door in scroll with latch-type handles.
 5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
 6. Inlet Screens: Removable wire mesh.
 7. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.
 8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
 9. Discharge Dampers: Assembly with [parallel] [opposed] blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
 10. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 11. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2.9 HIGH VOLUME, LOW SPEED FANS

- A. Manufacturers:
 1. Big Ass Fans (BAS)
 2. Greenheck
 3. MarcoAir
- B. Construction: Fan shall TUV certified and built pursuant to the construction guidelines set forth by the UL standard 507 and CSA standard 22.2. No. 113. The fan shall be designed to move an effective amount of air for cooling and destratification in commercial applications. The fan shall incorporate a direct drive system designed specifically for high volume, low speed fans to ensure silent operation. The sound levels from the fan operating at maximum speed shall not exceed 40 dBA (measured 20' or below the blades and 20' or horizontally from the center of the fan).

- C. Air Foils: The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high performance mini-elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless steel bolts and washers per airfoil.
- D. Winglets: The fan shall be equipped with eight (8) unswept winglets designed to redirect outward airflow downward, thereby enhancing the efficiency and effectiveness of the fan. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black.
- E. Trim: The fan shall be equipped with trim inserts that nest between the hub and the inner edge of the foil. The trim inserts (8 each) shall provide a cleaner fit between the airfoils and the hub to help reduce the drag, turbulence and the noise. Trim inserts shall be black.
- F. Motor: The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100-120 VAC, 1 PH, 60 HZ, without requiring adapters or customer selection. The motor shall be non-ventilated, heat sink design with the capability of continuous operation in -13° to 131°F ambient conditions. The standard color of the motor shall be white with silver trim or silver with black trim.
- G. Hub: The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.
- H. Mounting System: The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum are acceptable. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.
- I. Safety Cables: The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. All safety cables shall be 3/16" diameter and fabricated out of 7x19 stranded galvanized steel. The loops must be secured with swaged Nicopress fittings, pre-loaded and tested to 3,000 lbs. Field construction of safety cables in not permitted.
- J. Controller: The controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and breaking torques. The controller shall be housed in an enclosure to prevent accidental contact with the enclosed equipment and to prevent entry of unwanted substances.
- K. Fire Control Panel Integration: The fan shall be equipped with a 10-30VDC pilot relay for seamless fire control panel integration. Fans shall be interlocked to shut down

immediately upon receiving a waterflow signal from the alarm system in accordance with requirement of NFPA 72 – National Fire Alarm and Signaling Code.

- L. Wall Control: The fan shall be equipped with a low voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a rotary style dial for controlling the fans power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be a standard, commercially available CAT 5 (or higher) Ethernet cable that is field installed and provided by the installer.

- M. Warranty:

Furnish five (5) year manufacturer's warranty for high volume low speed fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable.

The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including all transportation charges).

- N. Accessories:

- 1. Provide clear lockable enclosure for wall controller with two sets of keys.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 34 23 - HIGH-PLUME BLOWER SYSTEMS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. High Plume Laboratory Exhaust Fans
- C. Related Sections:
 - 1. Section 23 31 13 – Metal Ducts - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.2 REFERENCE STANDARDS

- A. AMCA -99 Standards Handbook
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 211 - Certified Ratings Procedure.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 311 - Certified Sound Ratings Program for Air Moving Devices.
- F. AFMBA - Method of Evaluating Load Ratings of Bearings (ASA - B3.11).
- G. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- H. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- I. SMACNA - Medium Pressure Plenum Construction Standard.
- J. ANSI Z9.5 - Laboratory Design
- K. ASHRAE - Laboratory Design Guide.

1.3 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 211 and 311. Fans must be licensed and bear the AMCA seal for Certified Sound and Air Performance.
- B. Classification for Spark Resistant Construction Conform to AMCA 99.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance.
- D. Balance Quality: Conform to AMCA 204.
- E. Each fan shall be tested before shipping. Motors to be tested for amperage draw.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide nozzle velocity of exhaust fan, total exhaust flow and discharge plume height at specified wind velocity.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions and O&M Manual.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no

additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

- E. Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

1.7 WARRANTY

- A. Furnish three (3) year manufacturer's warranty for entire assembly. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date of from shipment or start up will not be acceptable.

1.8 MAINTENANCE SERVICE

- A. Installing mechanical contractor shall furnish service and maintenance of fans for three (3) years from Date of Substantial Completion.
- B. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.
- C. Provide (1) one annual and (3) three quarterly unit inspections per year. Provide owner a copy of each inspection report upon completion.
- D. Perform work without removing fans from service during building normal occupied hours.
- E. Provide emergency call back service at all hours for this maintenance period.
- F. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- G. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
- H. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: One (1) for each belt-driven fan.
 - 2. Filters: One (1) set for each unit.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.

- B. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers:
 - 1. Greenheck Vektor H series
 - 2. M.K. Plastics
 - 3. Loren Cook
- B. Base fan performance at standard conditions (density 0.075 Lb/ft³).
- C. Each fan shall be direct driven in AMCA arrangement 2; refer to plans.
- D. Each fan to be equipped with 316 stainless steel lifting lugs for corrosion resistance.
- E. Fasteners exposed to corrosive exhaust shall be stainless steel.
- F. Curb cap shall be hot rolled coated with corrosion resistant coating.
- G. Fan assemblies that use flexible connectors that can fail and cause loss of laboratory containment shall not be acceptable.
- H. Fan assembly shall be designed for a minimum of 125-mph wind loading, without the use of guy wires.
- I. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

2.2 CORROSION RESISTANT COATING

- A. All fan and system components (fan, nozzle, windband and plenum) shall be corrosion resistant, factory coated with LabCoat™, a two part electrostatically applied and baked, sustainable, corrosion resistant coating system. Standard finish color to be gray.
- B. All parts shall be cleaned and chemically prepared for coating using a multistage wash system which includes acid pickling to remove oxide, increase surface area and improves coating bond to the substrate.

- C. The first powder coat applied over the prepared surface shall be a zinc rich epoxy primer (no less than 70% zinc) and heated to a gelatinous consistency (partial cure) at which the second powder coat of polyester resin shall be electrostatically applied and simultaneously be cured at a uniform temperature of 400°F.
- D. The coating system, a total thickness of up to 6 mils, is not affected by the UV component of sunlight (does not chalk), and has superior corrosion resistance to acid, alkali, and solvents. Coating system shall exceed 4000 hour ASTM B117 Salt Spray Resistance.
- E. Entire coating process shall be performed in fan factory and not in field.

2.2 FAN HOUSING AND OUTLET

- A. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
- B. Fan housing shall be welded steel with a minimum of 4 mils of HiPro Polyester Resin. No uncoated metal fan parts will be allowed.
- C. A high velocity conical discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 6,000 FPM. Discharge stack caps or hinged covers, impeding exhaust flow shall not be permitted.
- D. Provide housing drain for removal of rain and condensation.
- E. An access door shall be supplied in the housing allowing for impeller inspection or removal of impeller, shaft and bearings without removal of the fan housing.
- F. Standard finish color to be grey.

2.3 FAN IMPELLER

- A. Fan impeller shall be centrifugal, backward inclined, with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically Grade G6.3 per AMCA Standard.
- B. Fan impeller shall be manufactured of aluminum, fully welded and coated with a minimum of 4-6 mils of HiPro Polyester resin.

2.4 FAN BYPASS AIR PLENUM

- A. A bypass air plenum shall be provided for variable air volume systems. The plenum shall be provided with bypass air damper(s) for introducing outside air at roof level upstream of the fan, complete with bypass air weather hood and bird screen.
- B. The plenum shall be double-wall construction; LabCoat™ coated exterior and interior steel walls. Coating must meet section 2.2 for corrosion resistant coating. Plenums fabricated of plastics or resins which are combustible and have mechanical properties less than steel shall not be acceptable.
- C. The bypass air plenum shall be mounted on factory fabricated roof curb provided by the fan manufacturer.
- D. Fan designs that use inlet flexible connectors that can leak causing loss of lab exhaust shall not be permitted.

- E. Bypass air damper(s) shall be opposed-blade design for airflow control, airfoil design, fabricated of aluminum. Bypass damper(s) shall have plated steel damper rods, stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy duty control damper, Greenheck HCD-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.
- F. Fan isolation damper(s), shall be parallel-blade design, airfoil design, fabricated of aluminum. Damper(s) shall be coated up to 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Isolation damper(s) shall have plated steel damper rods, stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy duty control damper, Greenheck HCD-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.
- G. Isolation damper actuator(s), if scheduled, shall be factory mounted and shall be wired to a step-down transformer. Actuator and transformer are located in a weatherproof enclosure.
- H. Blower / Plenum vibration isolation shall be limited to neoprene / cork vibration pads.

2.5 FAN MOTORS AND DRIVE.

- A. Motors to be premium efficiency, standard NEMA frame, 1800 RPM, TEFC with a 1.15 service factor. A factory mounted NEMA 3R disconnect switch shall be provided for each fan. Motor maintenance shall be accomplished without fan impeller removal or requiring maintenance personnel to access the contaminated exhaust components.
- B. Fans submitted that use 900 RPM, 1,200 RPM, or are C-Face motors, shall include one spare motor per fan system, in accordance with ANSI Z9.5, section 4.14.7.4, CRITICAL SERVICE SPARES.
- C. Drive belts and sheaves shall be sized for 150% of the motor horsepower, and shall be readily and easily accessible for service, if required.
- D. Shaft to be polished and ground steel.
- E. Fan shaft bearings shall be Air Handling Quality, ball or roller pillow block type and be sized for an L-10 life of no less than 100,000 hours. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.
- F. Bearings shall have extended lube lines with Zerk fittings.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fans as indicated, with flexible electrical leads.
- B. Pipe housing drain to nearest drain.

- C. Install fans in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 34 39 - HIGH-VOLUME, LOW-SPEED PROPELLER FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. High-volume, low-speed propeller fans.
- B. Related Sections:

1.2 REFERENCE STANDARDS

- A. AMCA 99 - Standards Handbook; 2025.
- B. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- C. ASHRAE Std 55 - Thermal Environmental Conditions for Human Occupancy; 2023, with Errata (2024).
- D. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. UL 507 - Electric Fans; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of _____ with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.
- C. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Indicate installation instructions.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Ceiling fan sizing, placement, and performance shall be verified using computational fluid dynamics (CFD) analysis. At a minimum, the input data for the CFD analysis shall include the ceiling fan(s), significant obstructions to airflow at the floor level, and the actual space dimensions. As verification of performance, the submittal shall include results of the CFD analysis including, at a minimum, the following performance metrics determined in accordance with ASHRAE Std 55:
 - 1. Average air speed, minimum, maximum and average cooling effect from elevated air speed, Predicted Mean Vote.

2. Predicted Percentage Dissatisfied for seated and standing occupants in each occupied zone.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - a. Package for protection against transportation damage.
 - b. Provide markings to identify components consistently with drawings.

B. Storage and Handling Requirements:

1. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - a. Store in well-ventilated space out of direct sunlight.
 - b. Protect from moisture and condensation.
 - c. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.7 FIELD CONDITIONS

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA), pursuant to the complete terms and conditions of the Warranty in accordance to the following schedule:
 1. Mechanical: 15 years.
 2. Electrical: 7 years (no factory install); 15 years (factory install).
 3. Labor: 1 year.
 4. Mechanical: Defined as mechanical components of the fan, including, the gearbox, fan hub, motor frame, mounting, airfoils, and winglets.
 5. Electrical: Defined as electrical and electronic components of the fan, including the motor, motor drive, variable frequency drive, and any standard controller or accessories.
 6. The No Factory Install Warranty Period defined above for "Electrical" applies to proper installations by any other state-qualified or licensed electrical contractor.
 7. The Factory Install Warranty Period defined above for "Electrical" requires installation to be purchased from Big Ass Fans and performed by a factory-approved, Big Ass Fans Certified Installer.
 8. The Warranty Period for light kits is limited to 1 year (parts).
 9. All reasonable costs of repair or replacement will be paid or reimbursed provided customer obtains pre-approval.
 10. The Warranty period for any manufacturer defects or flaws to surface finishes is limited to 1 year.
 11. All products are considered for indoor use only unless specifically specified on the product label.
 12. Refer to executed warranty for more details.
- C. The warranty shall not require the submission of a post installation form or photographs of the installed fan(s) to the manufacturer for the warranty to be in effect.
- D. The warranty shall not require the periodic submission of maintenance records for the warranty to remain in effect.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. High-Volume, Low-Speed Propeller Fans:
 - 2. Fan Controllers:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).

2.3 GENERAL REQUIREMENTS

- A. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 507.
- B. Static and Dynamically Balanced: Comply with AMCA 204.
- C. Fabrication: Comply with AMCA 99.
- D. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- E. Enclosed Safety Switches: Comply with NEMA EN 10250.

2.4 HIGH-VOLUME, LOW-SPEED PROPELLER FANS

- A. Basis of Design Product:
- B. Number of Fan Blades: Four.
- C. Fan Diameter: 24 feet (7.315 m).
- D. Mounting Options: As indicated on Drawings. Install per manufacturer's recommendation.
- E. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 - 2. Bearings:
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - c. 100 percent factory tested.
- F. Disconnect Switches:
 - 1. Factory mounted and wired.
 - 2. NEMA EN 10250 Enclosure: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Finish for Painted Steel Enclosures: Provide manufacturer's standard, factory applied gray, or _____ unless otherwise indicated.
 - 4. Positive electrical shutoff.
 - 5. Wired from fan motor to junction box installed within motor compartment.
- G. Fan Controllers:
 - 1. Basis of Design Product:

2. Factory mounted and wired.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure fan with stainless steel lag screws to structure.
- C. Provide sheaves required for final air balance for belt-driven motors.

END OF SECTION 23 34 39

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Air devices.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Titus
 - 2. Price
 - 3. Krueger
 - 4. Metalaire
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
 - 2. "T" Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.

- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.
 - 1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".
 - 2. Shall have a fire resistance rating of 3 hours.
 - 3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
 - 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 - 5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
 - 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
 - 1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
 - 1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers

- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.
- C. Install diffusers, registers, and grilles level and plumb.
- D. 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 practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 74 13 – 100% OUTSIDE AIR, PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units with the following components and accessories such as but not limited to:
 - 1. Direct-expansion cooling.
 - 2. Hot-gas re-heat.
 - 3. Gas furnace.
 - 4. Integral, space temperature controls.
 - 5. Roof curbs.
- B. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare the following:
 - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting 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. Structural members to which RTUs will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.

- B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- C. Startup service reports.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Filters: Furnish two (2) sets for each air handling unit. One set at substantial completion and a final set for owner storage. All Filters shall be labeled according to size and air handling unit it serves and protected with polyester fabric at all times during construction. Final attic stock set shall be delivered to Round Rock ISD Maintenance in protective wrapping. All air filtration during construction and testing and balancing shall be by installing mechanical contractor.

1.7 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. 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.

1.8 WARRANTY

- A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. **Warranty shall begin from date of Certificate of Substantial Completion.** Provide a sample of manufacturer's warranty certificates as described below within equipment submittal. **Warranty start dates from shipment or startup will not be accepted.**
- B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for rooftop units. All components to be included such as but not limited to refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor, compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.
- C. In addition to full machine parts, labor and refrigerant, the Standard warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.9 FACTORY TESTING

- A. All units shall be factory assembled, internally wired, fully charged with refrigerant, and 100% tested prior to leaving the factory. Certified factory testing report shall be sent to owner and engineer upon request. The factory test shall include a refrigerant circuit test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection. If unit fails any portion of the certified test, failures shall be corrected before unit leaves the factory.
- B. If for any reason unit does not meet the manufacturer's standards, those items shall be corrected and re-tested prior to leaving the factory with no additional cost to the owner.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. York – JCI (Basis of Design, for existing RTU-1 thru RTU-4)
 - 2. Trane – (Basis of Design, for OA-RTU-01,02 and RTU-5)
 - 3. Daikin
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts and performs final unit inspection.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Construction:
 - 1. Thermal break double wall.
- C. Exterior Casing Material: 18-gauge galvanized steel with factory painted finish capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Roof panels shall be pitched with overhangs above access doors, and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Interior Casing Corrosion Protection: All exposed metal surfaces in the air tunnel except the coils, coil casings, condensate drain pans, damper gears, and actuators, are spray coated with a two-part polyurethane, heat baked coating. Selection covers coating of the supply fans, filter rack, dampers, economizer, service door interiors, control cabinet, and condenser section interior. Option is intended for use in coastal saltwater conditions under the stress of heat, salt, sand, and wind and is applicable to all corrosive environments where a polyurethane coating is acceptable. The coating shall withstand at least 2,500 hours when tested under ASTM B 117-95 requirements.
- E. Casing Fabrication Requirements:

1. Inside casing: 18 Gauge galvanized steel.
- F. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- G. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
- H. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
- I. Unit base pan shall be provided with minimum 1-inch-thick foam insulation.
- J. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM D1929-11 with a minimum flash ignition temperature of 610°F.
 2. Double wall thickness and density: 2 inches, 3 lbs. density engineered polymer foam injected.
- K. Condensate Drain Pans: Formed sections of welded Type 304 stainless-steel sheet, a minimum insulation of two (2) inches deep and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with expanded foam insulation with a thermal break and seal moisture tight.
 2. Cross break and pitch to drain connection.
 3. Drain Connections: Threaded nipple.
 4. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of the coil intermediate drain pan shall have a minimum of two drop tubes to main pan.
 5. Drain pans shall allow no standing water and must be accessible for cleaning.
- L. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- M. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- N. Base Rails: Full perimeter insulated galvanized rails for mounting on roof curb or pad as indicated.
- O. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

- P. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- Q. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

2.3 FANS

- A. Direct-Driven Supply-Air Fans: Single width, single inlet, direct drive plenum; with permanently lubricated, VFD driven motor resiliently mounted in the fan inlet. Painted-steel or aluminum wheels with solid steel motor shaft.
- B. Direct-Driven Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
 - 1. Low sound operating, PVC coated fan guard, to discharge vertically. FRP construction on condenser fans under 15-tons. Fully dipped and baked epoxy on condenser fan assembly is also acceptable.
 - 2. Condenser Fan Motor: Totally enclosed air over (TEAO), permanently lubricated ball bearings; resiliently mounted; overload protected. Motors shall be ECM, Electronically Commutated Motors, or VFD driven on all units.
 - 3. Provide factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
 - 4. Fan Safety Guards: Steel with corrosion-resistant coating.
- C. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- D. Supply Fan Motor:
 - 1. Comply with requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 2. Enclosure: Totally enclosed fan-cooled (TEFC).
 - 3. Supply fans shall be provided with a (VFD) variable frequency drive for balancing and soft start purposes. VFD shall be factory provided and installed and wired in a ventilated controls compartment by manufacturer prior to shipment. Externally mounted VFD's shall be provided in NEMA 3R enclosure.
 - 4. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on fan isolation sled with rubber in shear isolators. Fan wheel and motor shall be dynamically balanced after assembly. Furnish access to motor, drive, and bearings through hinged access doors.

2.4 COILS

- A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
- B. Leak Test: Coils shall be leak tested with air underwater.
- C. Supply-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
 - 5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.
- D. Outdoor-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor. Aluminum microchannel construction in aluminum casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. All condenser coils require louvered panels for added protection of the condenser coils from hail and other physical damage.
- E. Hot-Gas Reheat Refrigerant Coil (Required):
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor. Or aluminum microchannel construction in aluminum casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
 - 5. Shall be available and provided as a factory installed option. Hot-gas reheat coil shall be modulating control. On/off control not acceptable.
 - 6. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
 - 7. Evaporator temperature to be precisely controlled by monitoring the compressor saturated suction temperature.

8. Shall be capable of simultaneously operating both the non-hot-gas reheat compressor circuits and hot-gas reheat compressor circuits of multiple compressor units when both the humidity level and the first stage cooling temperature level exceed their set points.
9. Shall be capable of prioritizing a cooling demand over a dehumidification demand and shut off the hot-gas reheat coil circuit(s) to meet the temperature requirements. Shall be able of turning the hot-gas reheat coil back on if the dehumidification demand still exists after the cooling demand has been met.
10. Shall consist of a reheat coil, three-way solenoid valve, a check valve and associated copper piping.
11. Reheat coil shall be constructed with enhanced aluminum fins mechanically bonded to copper tubes. Fin count shall not exceed 14 fins per inch.
12. Reheat coil shall be located on the leaving air side of the evaporator coil.
13. Three-way solenoid valves shall be non-modulating type and normally closed for the reheat coil.
14. Check valve shall be provided to prevent reverse flow of refrigerant during cooling operation.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.
- C. Compressors: Scroll compressors mounted on integral vibration isolators, internal overcurrent and high temperature protection, internal pressure relief and crankcase heater.
- D. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.
- E. Refrigerant: R-454B (A2L, blend) or R-32 (A2L, pure compound).
 1. Classified as Safety Group A2L according to ASHRAE 34.
 2. Provide unit with operating charge of refrigerant.
- F. Refrigeration System Specialties:
 1. Expansion valve with replaceable thermostatic element.
 2. Refrigerant filter/dryer.
 3. Manual-reset high-pressure safety switch.
 4. Automatic-reset low-pressure safety switch.
 5. Minimum off-time relay.

6. Automatic-reset compressor motor thermal overload.
7. Brass service valves installed in compressor suction and liquid lines.
8. Low-ambient kit high-pressure sensor.
9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
10. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.

G. Capacity Control:

1. For unit's ≤ 2 nominal tons: Single circuit, single compressor with on/off or two-stage (100% / 67%) compressor.
2. For units 3 to 10 nominal tons: Single circuit, single digital scroll, or inverter VFD compressor.
3. For units > 10 and ≤ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of two compressors; a digital scroll or inverter VFD compressor shall be used on the lead refrigerant circuit and a staged compressor shall be used for the lag circuit.
4. For unit's ≥ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of four compressors. A digital scroll or inverter VFD compressor shall be used on both refrigerant circuits. On each circuit, provide a lead digital or inverter VFD compressor and an on/off lag compressor.
5. Evaporator temperature is to be measured and controlled by suction pressure transducers on each refrigeration circuit. The use of coil discharge temperature sensors is not acceptable.

H. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.6 AIR FILTRATION

- A. The filter rack shall be designed to handle a maximum 2" thick high efficiency filter. Filters replaceable through side access, hinged access door.
- B. Provide the following filter racks and media:
 1. SA Upstream of Coil: MERV 13.
- C. Replaceable Filter Media: As indicated above or greater rating in accordance with ASHRAE Test Standard 52.2.
- D. High-Capacity Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches w.g; dirty pressure drop of 0.75 inches w.g.
- E. Filter Area: Max velocity of 350 FPM.

- F. Acceptable manufacturer: American Air Filter or prior approved equal.

2.7 GAS FURNACE HEATING

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners:
1. Heat-Exchanger Material: Stainless steel with a minimum thermal efficiency of 80 percent.
 2. Fuel: Natural gas.
 3. Ignition: Electronically controlled electric spark with flame sensor.
- C. Heat-Exchanger Drain Pan Material: Stainless steel.
- D. Venting: Gravity vented.
- E. Safety Controls:
1. Gas Control Valve: Electronic modulating.
 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

- A. Outside Air and Economizer Damper Assembly: Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood and adjustable barometric relief dampers.
- B. Damper blades shall be gear driven and designed to meet smoke damper Class-1 leakage specifications in accordance with U.L. 555S at 4 inches w.g. air pressure differential across the damper.
- C. Damper assembly shall be controlled by spring return, modulating actuator.
- D. Once set, outdoor air dampers shall open to the minimum set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
- E. Bird Screen: Provide 1-inch aluminum mesh pre filter upstream of the outside air opening.
- F. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.9 ELECTRICAL POWER CONNECTION

- A. Provide single connection of power to unit with unit factory mounted disconnect switch accessible from outside unit.

- B. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- C. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered convenience outlet connection shall be a separate electrical feed and not from the main.
- D. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key.
- E. Wiring: Numbered and color-coded to match wiring diagram.
- F. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- G. Power Interface: Field power interface shall be to [wire lugs] [NEMA KS 1, heavy-duty, non-fused disconnect switch].
- H. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- I. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- J. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity. Convenience outlet shall be a separate electrical connection and not powered from the main electrical feed.
- K. Controls: Factory wire unit-mounted controls components to a terminal strip for connection to third party BAS controller.
- L. Control Relays: Auxiliary and adjustable time-delay relays.
- M. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.10 CONTROLS

- A. Refer to Sequences of Operation within Controls specification.
- B. BAS Interface: Completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions including space temperature, leaving air temperature, space humidity, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times and diagnostics. The system shall be provided with all required temperature sensors, pressure sensors, controller, and keypad/display operator interface. All microprocessor boards, hardware and software shall be factory provided and installed to enable the BAS to monitor, control, and display unit status and alarms.

- C. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.
1. Unit controller shall be capable of controlling all features and options of the unit.
 2. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 3. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 4. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.

2.11 ROOF CURBS (PROVIDED BY RTU MANUFACTURER AND NOT “BY OTHERS”):

- A. Roof Curb shall be constructed of G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply openings and provide support and a watertight seal. The roof curb design shall allow field-fabricated rectangular supply ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curbs shall be shipped fully welded and insulated and include wood nailer strips.
- B. **Curbs shall be rated for a minimum of 155 mph and certified by structural engineer upon submittal. Certification shall be provided within submittal for approval.**
- C. Provide sound attenuation manufactured by **BRD HUSHCORE DS-49 Noise Control System** and shall be in full compliance with the following specifications:
1. The overall installed thickness shall be 14” for DS-49 products.
 2. Shall meet Class “A” per ASTM E84 for flammability.
 3. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb.
 4. System shall be plenum rated.
 5. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-49 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	<u>80</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>8K</u>	<u>STC</u>
TL (dB)	17	25	39	51	59	62	67	74	49

6. Copy of test report by an accredited lab shall be included in the submittals to document the above performance.

7. The mechanical contractor shall provide evidence of the in-curb acoustical treatment installation prior to lowering of the rooftop unit to the acoustical manufacturer. The acoustical manufacturer shall issue a letter of certification stating that the products have been properly installed and sealed around all ductwork and drops to eliminate air gaps which can compromise performance.
- D. Comply with requirements in "The NRCA Roofing Manual."
- E. Match roof curb to roof slope to provide level surface for RTU mounting.
- F. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft²-°F or greater.
- G. Provide curb with continuous insulation between unit base and roof curb. All walls are to be insulated with 2" fiberglass insulation; floor to be insulated with 1" fiberglass insulation.
- H. Curb height shall be a minimum of 14".
- I. All curbs shall be provided with minimum 12-gauge wind clips.
- J. Roof Curb for Horizontal Airflow (where scheduled) - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.
- K. Provide wood nailing strip to which roofer may nail roof flashing.
- L. Ship roof curb loose for field installation prior to unit placement.

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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.

3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- D. Install separate devices furnished by manufacturer and not factory installed.
- E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- F. Unless shown to come through roof curb to internal drain install drainpipes from unit drain pans to approved roof drain.

3.3 CONNECTIONS

- A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Gas Piping Connections:
 1. Comply with requirements in Section 22 00 23 - Gas Piping.
 2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 3. Install AGA-approved flexible connectors.
- D. Coordinate duct installation requirements with schematics on Drawings and with requirements specified for duct systems.
- E. Duct Connections:
 1. Comply with requirements in Section 23 31 13 - Metal Ducts.
 2. Drawings indicate the general arrangement of ducts.
 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 - Air Duct Accessories.
- F. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

- A. A factory-authorized service representative shall perform startup service.
 1. Complete installation and startup check according to manufacturer's written instructions.
 2. Inspect units for visible damage to furnace combustion chamber.

3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.
5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
7. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 1. Inspect casing insulation for integrity, moisture content, and adhesion.
 2. Verify that clearances have been provided for servicing.
 3. Verify that controls are connected and operable.
 4. Verify that filters are installed.
 5. Clean coils and inspect for construction debris.
 6. Inspect operation of power vents.
 7. Purge gas line.

8. Inspect and adjust vibration isolators and seismic restraints.
 9. Verify bearing lubrication.
 10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 11. Adjust fan belts to proper alignment and tension.
 12. Start unit.
 13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 14. Operate unit for run-in period.
 15. Calibrate controls.
 16. Adjust and inspect high-temperature limits.
 17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 18. Verify operational sequence of controls.
 19. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air flow.
 - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain units.

3.7 COMPLETION AND CLEANUP

- A. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet prior to start-up.

- B. Install temporary filters during construction and start-up period. Replace with specified filters at Substantial Completion.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation

END OF SECTION 23 74 13

SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART I -GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL REQUIREMENTS

- A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.
- B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).
- C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.
- D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
- E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.
- F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carrier.
 - 2. Daikin.
 - 3. Mitsubishi.

1.4 SUBMITTAL:

- A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.

- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- D. Product Data: Submit product data, including manufacturer's □ product sheet for specified products.

1.5 WARRANTY

- A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

- A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

- A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

- A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

2.4 FANS

- A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and

discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

- A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

- A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.
- B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.
 - 1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
 - 2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.
- C. The unit shall have the following functions as a minimum:
 - 1. An automatic restart after power failure at the same operating conditions as at failure.
 - 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - 3. Temperature-sensing controls shall sense return air temperature.
 - 4. Indoor coil freeze protection.
 - 5. Wireless infrared remote control to enter set points and operating conditions.
 - 6. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - 7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - 8. Fan-only operation to provide room air circulation when no cooling is required.
 - 9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
 - 10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.

11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 3. Fan 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.

3.2 STARTUP SERVICE

- A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

SECTION 26 05 00 - 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 01 Specification Sections, apply to this Section.

1.2 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.3 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.5 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.

- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.6 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.8 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

- A. Provide allowance in bid for twenty-five 20A/1p circuits of 100 feet in length from source for miscellaneous needs during the course of construction. Include one duplex receptacle per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- B. Provide allowance in bid for twenty-five light switching circuit drops of twenty feet in length for miscellaneous needs during construction. Include one 277V light switch per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- C. Provide allowance in bid for ten additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.

- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete system of building wire and cable to all electrical loads.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Southwire
 - 3. General Cable Co.
 - 4. IUSA Wire
 - 5. Encore
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.

- D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

- A. Manufacturers:
 - 1. AFC
 - 2. Southwire
- B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- C. Comply with NEC 320.
- D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- E. Provide an insulated green grounding conductor in all Type AC cable.
- F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.

- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
<u>System/Phase</u>	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
 2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed in exposed spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 23 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

- A. This paragraph shall apply to buildings when a ground ring is specified.
- B. Convene minimum one (1) week prior to commencing work of this section.

- C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

- A. Convene prior to cover up of work of this section.
- B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts
 - 6. VFC
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch
 - 3. Length: ten (10) feet

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. VFC

- B. UL Listed for grounding applications.
- C. Provide "ACORN" style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.
- D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSSES

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
 - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
 - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
 - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
 - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
 - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
 - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
 - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
 - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with NEC Article 250 Properly maintain the existing neutral-ground bond. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
 - 2. Size bonding jumper per NEC Table 250.66.
 - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
 - 1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless otherwise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.
- I. Made Electrode:
 - 1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in

- an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
 3. Install grounding electrode conductor of 3/0 Copper.
- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 2. Provide in each IDF and MDF room.
 3. Provide at each CATV / MATV head-end mounting board.
 4. Provide at each building communications rack.
 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.
1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
 2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Ground Ring Electrode (NEC 250-52):
1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.
- O. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
 2. Gas piping shall not be used as a grounding electrode.
- P. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
 2. Sign: Provide a sign at the service entrance equipment indicating type and

location of on-site generator.

Q. Outdoor Lighting Poles:

1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
1. The main building service is the source for electric service to several out buildings on site.
 2. Isolate neutral bus from ground at each out-building main panel.
 3. Provide an equipment grounding conductor in feeder to each out-building main panel.
 4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
 5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.
- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

A. Grounding Tests:

1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
2. Provide written test report to document all findings, test values, work done and certification of grounding system.
3. Use true-RMS meters for all voltage and current measurements.
4. Test telecommunications grounding riser to verify continuity.
5. Check all isolated ground receptacles for correct polarity.

6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
8. Verify continuity and isolation of audio system ground bus and grounding riser.
9. Perform ground resistance and continuity testing in accordance with IEEE 142.
10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
 1. Designated Ground Rods:
 - a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
 - b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
1. Dow Corning Corp.
 2. Fire Trak Corp.
 3. Hilti Corp.
 4. International Protective Coating Corp.
 5. 3M fire Protection Products .
 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
1. Furnish UL Listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.

- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.6 COORDINATION

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Multi Cell
 - 7. O-Z Gedney
 - 8. Raco.
 - 9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.
- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
 - 1. Manufacturer:
 - a. Ocal Inc.
 - b. Perma Cote Industries
 - c. Rob-Roy Industries
 - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
 - 1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
 - 2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
 - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.3 WIREWAY

- A. Manufacturers: Same as Metal Conduit.
- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

2.5 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
 - 1. Floor: Fully adjustable before and after pour.
 - 2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
 - 3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
 - 4. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.
- C. Manufacturers:
 - 1. Appleton
 - 2. Carlon
 - 3. Crouse-Hinds
 - 4. Hubbell
 - 5. Thomas & Betts / Steel City
 - 6. Walker

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.

- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Under Slab on Grade: Schedule 40 PVC.
 - 2. Outdoor Locations, Above Grade: Rigid galvanized steel.
 - 3. Wet and Damp Locations: Rigid galvanized steel.
 - 4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
 - 5. Underground:
 - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs,

- parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
- b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
- 6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
 - 7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
 - 8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

- A. Adjust floor box flush with finish material.

3.10 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
 - 1. 1/4 inch high letters for identifying individual equipment and loads.

- D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
 2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
 3. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and

document the testing. The Contractor shall sign the test reports to verify tests were performed.
See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 26 09 14 - ELECTRICAL CONTROLS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract and the requirements of Section 26 05 00 apply to Work specified in this Section.

1.2 SUMMARY

- A. Provide complete and operational electrical control systems as outlined within this Section.
- B. Refrigerant detection and alarm system is provided by Division 23 Mechanical.
- C. Elevator Shutdown System(s): All heat detectors, supervisory addressable modules, and supervised fire alarm wiring shall be furnished and installed as part of building fire alarm system. Refer to section 28 31 00 for additional requirements of fire alarm system.

1.3 SUBMITTALS

- A. Provide submittals according to Section 26 05 00. Coordinate with section 28 31 00 Fire Alarm System Submittal for Items to be furnished and installed as part of the Fire Alarm System.
- B. Product Data:
 - 1. Component manufacturer's literature explaining all components of each system.
- C. Shop Drawings:
 - 1. Complete point to point interface and control wiring schematics.
 - 2. Show size and location of all fused elevator shutdown switches and panels. Identify all fuse types, quantity and ampacity.
- D. Closeout Submittal: Provide manuals as described in Section 26 05 00.

1.4 OWNER'S INSTRUCTION

- A. Provide a one hour period of instruction for each system to the Owner's designated personnel upon completion of system installation. Instruction shall include a functional training session on operation and system test procedures.
- B. Elevator Power Shutdown System: Schedule instruction after building fire alarm system becomes operational. Demonstrate that heat detector(s) is connected to the building fire alarm system and that fire alarm system output connects into shunt trip circuit of the elevator power shutdown switch(s).

1.5 EXTRA MATERIALS

- A. General: Provide extra material's for Owner's use. All parts shall be identical to installed components.

- B. Fuses:
1. Full Set: A full set is (three phase) of each different ampacity fuse in an elevator shutdown panel and in each elevator shutdown switch.
 2. Provide two full sets of spare fuses for each elevator shutdown panel and switch. Fuses blown and replaced during construction and commissioning do not count as spares.
 3. Provide a metal cabinet in each elevator machine room for the spare fuses. Cabinet shall be furnished by the fuse manufacturer or approved equal.

PART 2 - PRODUCTS

2.1 REFRIGERATION MACHINERY ROOM EMERGENCY SYSTEM:

- A. General: Provide switches outside each exits from the central plant refrigeration machinery room as required by the Uniform Mechanical Code. Refer to Mechanical Drawings for sequence of operation for chiller machine room "purge" system.
- B. Emergency Purge Ventilation Fan Switch (EPS):
1. Function: Comply with Uniform Mechanical Code 1107.5. Provide a break-glass switch arranged for ON-only control of fan(s) used for emergency purge ventilation system for refrigerant escape. EPS shall require manual resetting.
 2. Construction: Switch shall be designated for surface mounting with contact blocks rated 125 Volts ac, 10 amps continuous, and include a cast box, glass cover and permanently attached break glass hammer. Switch shall be Allen Bradley 800T-NX115, ASCO Cat No. 124302, Crouse-Hinds EFSC21095 Series, Square D Class 9001 Type K15 on FD box, or approved equal.
 3. Label: Switch shall be permanently labeled "Emergency Purge Switch".
 4. Location: Immediately adjacent to-within two feet-and outside of each refrigeration machinery room exit.
- C. Emergency Refrigeration Switch (ERS):
1. Function: Comply with Uniform Mechanical Code 1108.4. Provide a break-glass switch arranged for OFF-only control of all electrically operated machinery in the refrigeration machinery room, except the exhaust ventilation system controlled by the EVS. Lighting fixtures shall not be affected by the ERS. Upon activation, the ERS shall immediately shutdown machinery. After shutdown, manual resetting shall be required to restore power to each chiller and motor affected. Loss of power from the Electric Utility, temporary or sustained blackout, shall not cause the ERS to operate.
 2. Construction: Switch shall be designated for surface mounting with OFF-only contact blocks rated 125 Volts ac, 10 amps continuous, and include a cast box, glass cover and permanently attach break glass hammer. Switch shall be Allen Bradley 800T-NX115, ASCO Cat No. 124302, Crouse-Hinds EFSC21095 Series, Square D Class 9001 Type K15 on FD box, or approved equal.
 3. Color: Switch shall be painted bright RED.
 4. Label: Switch shall be permanently labeled "Emergency Refrigeration Switch".
 5. Location: Immediately adjacent to-within two feet-and outside of each refrigeration machinery room exit.

2.2 ELEVATOR POWER SUPPLY AUTOMATIC DISCONNECT SYSTEM:

- A. General: Provide an elevator power automatic disconnect system in each elevator equipment room as required by ASME A17.1 Elevator Safety Code Rule 102.2 (c). Heat detectors and other parts of automatic disconnect means shall be separate from, and independent of, the building fire alarm system. Disconnecting means shall not be self-resetting.
- B. State Regulation: Make arrangements for all inspections required by State of Texas. Correct any deficiencies in elevator electrical power supply automatic disconnect system that may be noted by State elevator inspector. Repeat until successful completion of all State of Texas Inspection Reports and Certificates of Compliance as required for ELEVATORS, ESCALATORS AND RELATED EQUIPMENT by the Texas Department of Licensing and Regulation.
- C. NFPA: Comply with National Fire Protection Association Standard 72-1999, National Fire Alarm Code, Sect. 3-9.4 (1996 NFPA 72 section 3-8.15).
- D. Disconnecting Means:
 - 1. Single-Car Machine Room: Provide Bussmann Power Module Switch Cat. No. PS in NEMA 3R enclosure. Switch rating amps shall be next size larger than fuses. All fuses shall be Class J current-limiting fuses. Provide shunt trip, 120 Volt control power transformer, Bussmann Option R2 fire alarm interface relay and key test switch for elevator feeder. Entire assembly shall be UL-listed and have 200,000 RMS symmetrical ampere interrupting rating.
 - 2. Class J Fuse Sizing: 175% Full Load Amps per elevator motor.
 - 3. Enclosure: NEMA 3R.
 - 4. Label: Label shunt-trip fused switch "Elevator Automatic Disconnect".
 - 5. Install wiring to remote heat detectors. Bussmann Option A: Comply with NEC 620-91 (c). For each hydraulic elevator that has automatic recall, provide one Bussmann Option A with fused switch for that elevator shutdown. Option A is a normally-closed mechanical interlock. It prevents inadvertent recall of hydraulic elevator. Automatic recall for hydraulic elevator is typically a Division 14 item for battery pack and electric solenoid on the hydraulic valve at the elevator controller. Automatic recall is typically provided when the hydraulic elevator is not on standby generator power.
- E. Heat Detector:
 - 1. Install an approved heat detector with replaceable heat element within two feet of each sprinkler head in each elevator equipment room, each elevator pit, and in each elevator hoistway. Connect all heat detectors to contactor shunt trip(s) described above. Heat detector shall cause shunt trip to open the contactor associated with each elevator fused switch.
 - 2. Heat detector shall have a lower temperature rating than the sprinkler head. Ex. 135°F-fixed temperature detector versus 165°F sprinkler.
 - 3. Heat detector shall also have higher sensitivity than sprinkler. Detector higher sensitivity is often characterized by lower response time index (RTI). Listed spacing of heat detector shall be 40 feet or greater (NFPA 72, sect. Appendix 3-8.15.1).
 - 4. Heat detector shall be combination rate-of-rise and fixed-temperature design as recommended in ASME Handbook to ANSI/ASME A17.1 Safety Code for Elevators and Escalators, explanation for Rule 102.2 (c)(3).
 - 5. Install a heat detector at each sprinkler head in all following locations that have sprinklers:
 - a. Elevator machine rooms;
 - b. Elevator hoistway;

c. Elevator pit.

6. Heat detector shall be Notifier Model No. HD-621 or approved equal. Detector shall have Normally Open, dual output contacts. Both contacts shall be rated at least 3A @ 6-125 Vac and 1A @ 6-28 Vdc.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All components shall be properly mounted and wired.

3.2 INTERFACE WITH INVOLVED EQUIPMENT:

- A. Each system shall have all necessary control circuitry, relays, and contacts to provide functions as specified, and shall be capable, if necessary of interfacing to voltages 12-120 AC/DC, N/O or N/C contacts, wet or dry contacts, and momentary or maintained signal required. Verify type of interface control required with manufacturer of associated equipment. Provide necessary control power system for any wet contacts that are required, including control transformers, rectifiers, wiring, circuit breakers, etc.

3.3 CONTROL POWER SUPPLY:

- A. Elevators: Provide 120 volt control power as required from the same 208/120 volt circuit breaker panelboard serving the various 120V branch circuits in the elevator machine room.

3.4 ELEVATOR DISCONNECT:

- A. National Electrical Code:

NEC 620-51 (b): Provide a disconnecting means for main power supply conductors to each elevator car. The elevator disconnecting means shall be part of the automatic shutdown system to open the power supply prior to application of sprinkler water.

NEC 620-51: The disconnecting means for the main power supply conductors to each elevator car shall not disconnect the branch circuits required by NEC 620-22, 620-23 and 620-24.

3.5 TESTING:

- A. Test each system in the presence of the Owner, Architect, and Engineer to verify proper operation of elevator power supply automatic disconnect systems.
- B. State Elevator Inspector: Include State Elevator Inspector in test witnessing. At the sole option of the State Elevator Inspector, provide separate testing as that person may require. Provide all testing of disconnect systems as required by State Elevator Inspector to allow all Inspection Reports and Certificates of Compliance to be completed.

END OF SECTION 26 09 14

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, size, voltage ratings and current ratings.
- B. Short circuit current rating (SCCR) of equipment.
- C. U.L. Label.
- D. Electrical characteristics of equipment.
- E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

- A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.
- B. Manufacturers:
 - 1. ASCO
 - 2. Square D
 - 3. GE
- C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.
- D. Lighting Contactors:
 - 1. Mechanically held, electrically operated.
 - 2. ASCO 918 or approved equal.

3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.
 4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
 5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
 6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.
- E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

- A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
 2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
 3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
 4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
 5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
 6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
 7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
 8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
 9. Listing: Photocell shall be listed by Underwriters Laboratories.
- B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

- A. Manufacturer:
1. Grasslin
 2. Intermatic
 3. Paragon
 4. Precision
 5. Tork

- B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.
- C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.
- D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.
- E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.
- F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.
- G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.
- H. Manual Bypass:
 - 1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
 - 2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.
- I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.
- J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.
- K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.
- L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.
- M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

2.4 DIGITAL TIME SWITCHES:

- A. Recessed in wall: Wattstopper TS-400 or approved equal.
 - 1. The digital time switch shall be programmable to turn lights off after a preset time.

2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

- A. Ceiling Sensors: Require power packs
 1. W-2000- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.

- DT-300- Low Voltage dual technology ceiling mounted with isolated contact.
Typical for classrooms.
2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern
- B. Wall Switch Sensors:
1. PW-100 Line voltage PIR wall switch sensor for 1 circuit- Typical for small office or single person restroom.
PW-100-24 Low Voltage PIR wall switch sensor. Requires power pack
PW-200- Line voltage PIR wall switch sensor for 2 circuits,
UW-100- Line Voltage ultrasonic wall switch sensor for 1 circuit.
DW-100- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
DW-200- Line voltage dual technology wall switch sensor for 2 circuits
2. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
3. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
4. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life/protects from the effects of inrush current, and increases sensor's longevity.
5. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
6. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
7. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
- C. Power and Auxiliary Packs:
1. BZ-50- Standard power pack for use with low voltage sensors. 225ma
2. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma
3. S120/277- Slave relay pack. For controlling more than 1 circuit from a low voltage sensor. Standard BZ-50 can also be used.
- D. High Ceiling Applications
1. HB-350B*LENS Low Voltage PIR sensor
2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
4. L4 Lens- 60' diameter coverage pattern when mounted at 60'
- E. Passive infrared sensors:
1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.
- F. Dual technology sensors:

1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
 2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- G. Ultrasonic sensors:
1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.
- K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- O. All sensors shall have UL rated, 94V-0 plastic enclosures.
- P. All occupancy sensors shall be set to maximum 30 minute time delay.
- Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-102 Daylighting Controller

- A. The light level controller shall be capable of detecting changes in lighting levels.
- B. The light level controller shall utilize an internal photocell that measures light in a 100 degree angle cutting the unwanted light from bright sources outside of this cone.
- C. The light level controller shall be capable of controlling any type of lighting through use of power packs. Light level controller shall operate from a 24 volts DC power supply; current draw is 22 milliamps.
- D. The LS-102 light level controller shall be capable of turning lighting on and off for a single zone and has a light sensors over 1 to 1400fc.
- E. The light level controller shall have an adjustable deadband feature with 25%, 50%, 75% or 100% in relation to the setpoints. This prevents lighting from cycling when lighting goes on and off and from minor changes due to cloud cover.
- F. The light level controller shall have an adjustable time delay range of 3, 10, 15 or 30 minutes. This will prevent cycling on partly cloudy days and is necessary with HID lighting.
- G. The LS-102 shall provide a connection for an optional low voltage, normally open momentary contact watt switch override.
- H. The LS-102 provides a “hold on while occupied” feature that prohibits high levels from turning OFF the controlled lights as long as the space remains occupied.
- J. The LS-101 has an ON Setpoint range from 1-850fc and when the daylight drops below that setpoint for 20 seconds the electric lights will be turned ON.
- K. The LS-102 has a microprocessor that allows the photosensor to respond with precision to deliver the desired intensity of electric lighting for the space.
- L. The light level controller has a LED status indicator making it easy to identify if the device has been forced on or off by an override switch or if the device is in test mode.
- M. The LS-102 has a threaded nipple that mounts on a ceiling tile and for more challenging applications such as a side wall or hard rock ceiling the nipple pops off and the LS-101 can be screwed down.
- N. Light level controller shall have standard 5 year warranty.

2.7 SPORTS LIGHTING CONTROL STATION

- A. General: Provide pushbuttons for manual override of programmable relays designated to control the power contactors for the outdoor sports lighting at each field. Arrange pushbuttons into a single enclosure for each field.
- B. Enclosure: Enclosure shall be NEMA 4X stainless steel or polycarbonate with gasketing for outdoor wet locations.
- C. Pushbutton: Similar to Square D Class 9001-Type B, Type BW245, NEMA 4, momentary contact, RED/ON and GREEN/OFF pushbuttons with collar guard.
- D. Wiring: From each pushbutton in the Sports Lighting Control Station, provide low voltage wiring to the programmable relay cabinet.
- E. Control: BAS schedules all power contactors for outdoor sports lighting via the programmable relay system. Each sports field shall have a programmable relay assigned to the contactors for the sports lighting of that field. BAS will program automatic schedules for the sports lighting as required. User shall be able to override automatic schedule from BAS with manual ON/OFF signals from the pushbutton Lighting Control Stations. Pushbutton signals relay cabinet, similar to a classroom light switch, and relay causes the lighting contactors to change state (OFF to ON, ON to OFF).
- F. Engraving: Provide engraved lamacore plate above each pushbutton describing the lighting it will control. Example: TENNIS COURTS; FOOTBALL-EAST POLES, FOOTBALL-WEST POLES, BASEBALL, SOFTBALL.
- G. Relays: For each pushbutton control, provide a relay in the local relay cabinet nearest the sports lighting contactors. Wire relay to the control circuits of the associated sports lighting contactors. Program BAS for both automatic scheduling of the sports lighting and to accept manual override from pushbutton Sports Lighting Control Stations.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

- A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

- A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

- A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".
- B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.
- C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

- A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

- A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Instruction shall include a functional training session on digital metering system operation and system test procedures. Demonstrate the transfer of metered values to the Building Automation System. Review manufacturer's recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
1. Square D
 2. Siemens
 3. G.E.
 4. Cutler-Hammer

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
 3. All current carrying parts shall be plated to resist corrosion.
 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
 5. Switches shall have provisions for a field installable electrical interlock.
- C. Switch Mechanism:
1. 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.
 2. The operating handle shall be an integral part of the box, not the cover.
 3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
 4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
 5. All 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.
- D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
 2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
 3. The enclosure shall have ON and OFF markings stamped into the cover.
 4. The operating handle shall be provided with a dual colored, red/black position indication,
 5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
 6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.

2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
3. Non-Fusible: 10,000 rms symmetrical amps.

F. Fuse Clips: NEMA FU 1, Class J fuses.

2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
 1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.5 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
 1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 7. Wiring: Straight-through wiring with all terminals clearly marked.
 8. Overload Relay: NEMA ICS.
 - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.

- c. Reset: Unit shall include both manual reset and remote reset using an external module.
- d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
- 9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
- 10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
- 11. Provide red LED running pilot light and H-O-A switch.

2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
 - 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
 - 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
 - 3. Coil: Be of encapsulated type.
 - 4. Poles: as indicated.
 - 5. Size: as indicated.
 - 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
 - 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 - 8. Wiring: Straight-through wiring with all terminals clearly marked.
 - 9. Overload Relay: NEMA ICS.
 - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
 - 10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
 - 11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
 - 12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
 - 13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.7 COMBINATION DISCONNECT / MOTOR STARTERS

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
 - 1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle.

- Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
 3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.8 FUSES (600 VOLTS AND BELOW)

- A. Manufacturers:
 1. Bussmann.
 2. Little Fuse
 3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
 1. Dimensions and Performance: NEMA FU 1.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.9 TWO-WINDING TRANSFORMERS

- A. Product Description: Provide transformers in accordance with the following standards, where applicable:
 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 3. NEMA ST 20, Dry Type Transformers for General Applications
 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
 6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.
- B. Ratings as indicated on Drawing.
- C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.
- E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.

- F. Winding Taps:
 - 1. 2 at 2.5 percent above rated voltage.
 - 2. 4 at 2.5 percent below rated voltage.
- G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.
- I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- J. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for floor mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- K. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.10 TRANSFORMERS FOR NONLINEAR LOADS

- A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.
- B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.
- F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.
- G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Square D I- Line, Class 2110.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Continuous current rating shall be sufficient to protect wiring and equipment served.
 - 1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
 - 2. Panels greater than 400A: 65,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Main Circuit Breaker:
 - 1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
 - 2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
 - 3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.
- G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.12 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.13 MOTOR CONTROL CENTERS

- A. General:
 - 1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
 - 2. NEMA Class: I.
 - 3. NEMA Wiring Class: Type B.
 - 4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
 - 5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.
- B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.
- C. Structure:
 - 1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
 - 2. Structures shall be totally enclosed, dead front, freestanding assemblies.
 - 3. Structure shall be NEMA type 1 gasketed general purpose.
 - 4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
 - 5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
 - 6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to allow room for power and control cable to connect between units in different sections.
 - 7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.
 - 8. Unused spaces and spares shall have hinged doors.
- D. Bussing:
 - 1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
 - 2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
 - 3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus

shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus ampacity, each space shall count no less than FLA of smallest motor served in that section.

4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.
5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.

E. Terminations:

1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
2. All starter units shall be provided with unit control terminal blocks.
3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.

F. Protective Devices:

1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load. Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.
2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.
3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
4. Starters: all starters for motor control center to be size 1 minimum or larger.

G. Short Circuit Current Ratings:

1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.
 2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
 3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.
 4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.
- H. Nameplate:
1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
 2. Provide a master nameplate on face of units similar to following, with correct data shown:
Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus: _____ amps. braced for _____ amperes RMS Symmetrical
Date Installed:
 3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
 4. Provide UL listing marks on each section and unit in manufacturer's standard format.
- I. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions
 3. Cable Termination Provisions
 4. Current Ratings
 5. Voltage Ratings
 6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).
 7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
 8. Identify NEMA Class of submitted mcc.
 9. Identify NEMA Wiring Type of submitted mcc.
 10. Single Phase Relay
 11. Unit Elevation
 12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
 13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

- A. General: Provide universal building-type switchboards fabricated in accordance with NEMA Standard PB-2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.

- B. Structure:
1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1-1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
 2. When "SPACE" is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.
- C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.
- D. Instrumentation:
1. General: Monitor the incoming line with a Square D Class 3020 ION S7650A0C0B6E0A0A.
Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
 2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).
- E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height.** Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full-size neutral rated at 100 percent of phase bus.
- F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.
- G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage.
- H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
 2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.

3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
 4. Refer to Section 26 35 33 for additional requirements of auto pf controller.
- I. Protective Devices:
1. Switchboard Main Breaker:
 - a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D NW (3000-4000), RJ (1600-2500A) 65KA or RL (1600-2500A) 100KA ampere frame size.
 - b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - c. Minimum interrupting rating of 65,000 amperes rms symmetrical at 480/277 Volts.
 - d. Local trip indicators: overload, short circuit and ground fault.
 - e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
 - f. Adjustments:
 - 1) The electronic trip unit shall have LSIG Trip functions.
 2. Feeder Devices:
 - a. Breakers 700 Amps and Larger:
 - 1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units, similar to Square DNW (3000-4000A, RJ (1600-2500A 65kaic 100%), RL (1600-2500A 100kaic 100%), PJ (700-1200A 65kaic 100%), or PL (700-1200A 100kaic 100%)
 - 2) Interrupting rating shall be at least 65,000 amperes rms symmetrical at 480/277 Volts.
 - 3) The electronic trip unit shall have LSI trip functions.
 - 4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
 - c. The breaker shall be UL Listed for continuous duty at 100% of the current rating
- J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.
- K. Lightning and Overvoltage Surge Arrester:
1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.

2. Description: Device shall be a heavy duty, three-phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.

L. Identification:

1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard _____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus: ___ amps. braced for ___ RMS sym. amps.
Date Installed:

M. Submittal: Include at least the following:

1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings
7. Protective Device Ratings
8. Electronic metering system
9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:

1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4 inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.
3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for

- Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.
4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
 5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.
- B. Electric Utility Requirements:
1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect. Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.
 2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
 3. Form roof with cross-kink to force water to run off the cabinet.
 4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
 5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
 6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.
 7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
 8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
 9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
 10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.
- C. Submittal to A/E: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions: plan, elevations, bus bars.
 3. Cable Termination Provisions
 4. Current Rating
 5. Voltage Rating

6. Short Circuit Withstand Rating
7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.16 SEQUENCING PANELBOARD FOR THEATER SOUND REINFORCEMENT SYSTEM:

A. Features:

1. Supply all ac circuits for audio/visual equipment in the high school theater A/V room from time sequence panelboard capable of being remote controlled from multiple locations.
2. 41 sequenced circuits per panelboard.
3. A means of visual operator feedback shall provide an indication of the progress of the power turn-on and turn-off sequence at each control point.
4. Sequencing shall have an adjustable time delay between the low level equipment circuits and the power amplifier circuits.
5. The sequencing system shall be capable of shedding the load within three (3) seconds after a power failuer and re-sequencing when power resumes without operator intervention.
6. Provide one LynTec Cat. No. SS-2 Sequencer Switch Set with every 41-circuit panelboard.
7. Provide one LynTec Cat. No. SS-2PL Remote Locking Switch Plate with every 41-circuit panelboard.
8. Provide for each sequencing panelboard a LynTec Model No. SLC 341-41 filled with MB-Motorized Breakers, 3 phase, 4 wire, 208Y/120 Volt 225 Amp Main Breaker panel or approved equal.
9. Acceptable Manufacturer: LynTec Inc., 8401 Melrose, Lenexa, KS 66214-1647; telephone 800-724-4047, fax 888-722-4157, www.lyntec.com or email info@lyntec.com.

B. Cabinet: Safety dead front type; box made of Code gage galvanized steel; minimum gutter space 4" on all sides but not less than NEC requirements; door with flush type latch. Enclosure shall conform to NEMA 1.

C. Circuit Breakers:

1. General: Provide a breaker for each audio branch circuit to protect wiring and equipment served.
2. Description: Each breaker shall have motor drive for individual breaker remote control. Breakers shall be quick make, quick break, trip free, thermal magnetic trip. Automatic trip shall be indicated by the handle at the midpoint position. Multiple pole breakers shall have common trip.

D. Short Circuit Ratings: 120/208 volt systems 10,000 amperes RMS symmetrical.

E. Phase, Neutral and Ground Bussing: Silver or tin plated 98 percent conductivity copper sized in accordance with NEMA Temperature Rise Standards and installed completely throughout panel for installation of future breakers where schedule shows space only. Provide an equipment grounding bus bonded to the panel cabinet. Ground bus shall have a terminal screw for every breaker in the panel.

- F. Termination: Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
- G. Surge Protective Device: Install a Transient Voltage Surge Suppressor (TVSS) on the sequencing panelboard. TVSS shall be Current Technology TransGuard TG60 Series or Liebert Interceptor Model 111 Series.
- H. Nameplate: Nameplate on front face showing panel name and voltage. Coordinate to give same name as shown on Drawings.
- I. Directory: Complete at end of job, typewritten, contained in frame on the inside of the panel door. Frame shall have a protective plastic shield. Label every breaker to match directory.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

- A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.
- B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.
- C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

2.18 ROOF MOUNTED PEDESTALS

- A. Roof Utility Pedestal with 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products utility roof pedestal #MPX-20G: 36/12.
- B. Roof Pedestal with Non-Fused Disconnect Switch and 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products roof pedestal #MDP – (XX). See plans for disconnect sizes.

PART 3 - EXECUTION

3.1 MOUNTING:

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
 - 1. Provide concrete in accordance with the Division of the Specifications for that product.
 - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
 - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.

- D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.
- E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

- A. General:
 - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
 - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
 - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
 - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
 - 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:
 - 1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
 - 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
 - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
 - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
 - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
 - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
 - 1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 POWER SHUT OFF UNDER KITCHEN HOODS:

- A. NFPA:
 - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
 - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
 - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. Coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

3.7 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
 - 1. Leviton 1224 Series, 20A, 120/277V.

- E. Indicator Switch, Toggle Style:
 - 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.
- F. Locator Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.
- G. Digital Time Switch:
 - 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.
- H. Key lock switches:
 - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
 - 2. 20 Amp rated.
 - 3. 120/277 Volt ac rated.
 - 4. Key-lock mechanism can only be turned ON or OFF with key.
 - 5. Single pole: Leviton 1221-2KL or approved equal.
 - 6. 3-Way: Leviton 1223-2kl or approved equal.
 - 7. 4-Way: Leviton 1224-2kl or approved equal.
 - 8. Provide 302 stainless steel wall plate for each switch.
 - 9. Provide 2 keys on ring for each switch.
 - 10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
 - 11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.
- I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.
- B. Leviton MMS Series.

2.4 WALL DIMMERS

- A. Manufacturers:
 - 1. Lutron Nova "T" Series.
- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.
- C. Body and Handle: Linear slide handle, color as selected by Architect.
- D. Voltage: 120 volts.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Leviton 5362A Series, 20A/125V.

- B. Duplex Convenience Receptacle:
 - 1. Leviton 5362 Series, 20A/125V, respectively.
- C. GFCI Receptacle:
 - 1. Leviton 7899 Series, 20A/125V.
 - 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
 - 1. Leviton 5362-IG, 20A/125V.
- E. Duplex Tamper Resistant Receptacle/ USB Charger
 - 1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.
- F. Provide 20 amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: As selected by Architect.

2.6 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

2.7 MANUFACTURERS

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
 - 1. Leviton
 - 2. Pass & Seymour
 - 3. Hubbell / Bryant
 - 4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.
- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Code: Article 285
- E. UL 1283 - Electromagnetic Interference Filters
- F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

- A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.
- B. Submittals shall include UL 1449 3rd Edition Listing documentation verifiable by visiting www.UL.com, clicking "Certifications" link, searching using UL Category Code: VZCA and VZCA2:
 - 1. Short Circuit Current Rating (SCCR)
 - 2. Voltage Protection Ratings (VPRs) for all modes
 - 3. Maximum Continuous Operating Voltage rating (MCOV)
 - 4. I-nominal rating (I-n)
 - 5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.
- C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.

- D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

- A. List individual units under UL 1449 (Third Addition) and UL 1283.
- B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.
- D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.
- E. Manufacturer shall be ISO 9001 or 9002 certified.
- F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept equipment on site in factory packaging. Inspect for damage.
- B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.
- C. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Manufacturers:
 - 1. Current Technology
 - 2. Liebert
 - 3. Siemens
 - 4. Square D
 - 5. GE
- B. Product Description: Surge protection devices for protection of AC electrical circuits.

- C. Unit Operating Voltage: As indicated on Drawings.
- D. Construction:
1. Finish: Factory finish of baked enamel.
 2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.
 3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
 4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
 - a. Continuous monitoring of fusing system.
 - b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
 - c. Monitor for overheating in each mode due to thermal runaway.
 - d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
 5. Labeling: Permanently affix UL 1449 (Third Addition) suppression voltage ratings and CSA to unit.
- E. Types:
1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
 2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard.
- F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).
- G. Switchboards:
1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
 2. SPD shall meet or exceed the following criteria:
 - a. Maximum 7-Mode surge current capability shall be 300kA per phase.
 - b. UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V
 3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/347	15%	320V
 4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.

5. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
 6. SPD shall include a serviceable, replaceable module.
 7. SPD shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter
- No other test equipment shall be required for SPD monitoring or testing before or after installation.
8. SPD shall have a response time no greater than 1/2 nanosecond.
 9. SPD shall have a 10 year warranty.
- H. Distribution and Lighting Panelboards:
1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
 2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL's home page. Type "VZCA" into the Category Code search box and click Search.)
 3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
 4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
 5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
 6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems
 7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
 8. SPD shall meet or exceed the following criteria:
 9. Minimum surge current capability (single pulse rated) per phase shall be:
 - a. Distribution applications:
 - 1) Siemens Model TPS3 09 with Maximum surge current capability of 100kA per phase
10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

11. SPD shall include a serviceable, replaceable module (excluding Distribution). (Deletable note: Delete or adjust as appropriate.)
12. Service Entrance SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
14. SPDs shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify mounting area is ready for equipment.
- B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

- A. Install in accordance with IEEE 1100.
- B. Install service entrance suppressors in switchboard.
- C. Install suppressors for panelboards adjacent to panel.
- D. Install surge counter in face of switchboard.
- E. Include surge counter for stand-alone SPD.
- F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.

- G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Provide luminaires listed by U.L.
 - 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 - 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide ten (10) percent spare lamps of each lamp type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- B. All luminaires shall be new and of specification grade.
- C. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- D. Wire guard at fixtures in mechanical, electrical, and high abuse areas.
- E. Acceptable Manufacturers:
 - 1. Cooper
 - 2. Lightolier
 - 3. Lithonia
 - 4. Metalux
 - 5. Day-Brite
 - 6. Columbia
 - 7. HE Williams

2.2 LED LUMINAIRES

- A. Quality Assurance
 - 1. DOE Lighting Facts certified.
- B. LED Specifications
 - 1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
 - 2. CRI: >82 minimum (general); >90 healthcare and retail.
 - 3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
 - 4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
 - 5. Outdoor luminaires to be rated at a minimum of 40° C.
- C. Lumen Maintenance
 - 1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25° C, outdoors at an ambient temperature of 40° C.
- D. Thermal Testing
 - 1. ISTM testing in accordance to UL 1598-2008.
- E. Driver
 - 1. 0-10V enabled.
 - 2. Output Class 2 rated.
 - 3. Dimming range: 5-100%.
 - 4. Constant current.
 - 5. THD @ max load: <20%.
 - 6. Power factor: >0.95
 - 7. Environment protection rating: UL Damp and dry.

- 8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
- 9. ROHS Compliant
- F. Fixture photoetry
 - 1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
 - 2. System flux measured in delivered lumens.
- G. Warranty
 - 1. 5 year total system warranty.

2.3 EMERGENCY BATTERY PACKS

- A. Provide Emergi-Lite FPSIU series, or approved equal, battery pack for fluorescent fixtures designated to have emergency battery back-up.
- B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.
- C. Provide unswitched alternating current power source per manufacturer's instructions.
- D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.
- E. For fixtures designated to have emergency battery pack and be on a contactor controlled circuit, provide unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.
- F. Battery pack shall provide 1100 lumen output for 90 minutes per 2'x4' light fixture.
- G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.4 DOWNLIGHT FIXTURES

- A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.5 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 "Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
 - 1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.
- D. Housing: Diecast aluminum with stencil face and matte white paint finish.

- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.6 OUTDOOR LUMINAIRE POLE ASSEMBLIES

- A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.
- B. Diesel Standard: 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.
- C. Minimum Wind Speed: 120 miles per hour.
- D. Metal poles shall comply with NEC 410-15(b).
- E. Pole Material: Steel.
- F. Pole Shape: Round tapered.
- G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.
- H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts. Contractor silicone the pole base covers to the top of the concrete base, leave ½" gap in silicone in center of each side for water to drain.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

- E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- F. Suspended Ceilings:
 - 1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
 - 2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
 - 3. Luminaires shall be centered in ceiling tile.
 - 4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
 - 5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.
- G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

3.6 LAMPS

- A. Clean all lamps after installation.

3.7 CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.
- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.8 OUTDOOR LUMINAIRE POLES

- A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.
- B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole refinished at pole factory.
- C. Installation:
 - 1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
 - 2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
 - 3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
 - 4. Minimum wire size for circuit tap inside pole shall be AWG #12.
 - 5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.
- D. Fusing:
 - 1. Install fuse holder and fuses as noted in pole base detail on Drawings.
 - 2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

3.9 RFI

- A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00

SECTION 27 00 00 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED WORK

- A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.03 SCOPE OF WORK

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.04 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.

- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.05 CODES AND STANDARDS

- A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.
- B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
- C. ANSI/TIA:
1. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single- Mode Fiber Cable Plant
 2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single- Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 5. ANSI/TIA-568.0-D (September 2015) Generic B (supersedes TIA-568-C.0 and TIA-568- C-1)
 6. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 7. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
 8. ANSI/TIA-568.4-D (August 2020) Broadband Coaxial Cabling Components Standard
 9. ANSI/TIA-569-E (May 2019) Telecommunications Pathways and Spaces
 10. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
 11. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 12. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
 13. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 14. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 15. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 16. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
 17. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
 18. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to

- TIA- 1005-A
19. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 20. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun- Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
 21. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 22. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
 23. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
 24. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
 25. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
 26. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
 27. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
 28. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
 29. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
 30. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted- Pair Cabling
 31. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
 32. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
 33. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
 34. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
 35. TIA-492AAAE (June 2016) Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser- Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
 36. TIA-492AAAB-A (November 2009) Detail specification for 50-µm core diameter/125-µm cladding diameter class 1a graded-index multimode optical fibers
 37. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of- Polarization Analysis
 38. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
4. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
5. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
6. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
7. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation

- of customer premises cabling – Part 1: Administration
 - 8. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
 - 9. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
 - 10. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling
 - 11. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
 - 12. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
 - 13. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment
- E. BICSI – Building Industry Consultative Services International – Published Standards
- 1. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 - 2. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
 - 3. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
 - 4. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 - 5. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
 - 6. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
 - 7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - 8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - 9. BICSI – Building Industry Consultative Services International – Manuals
 - 10. Telecommunications Distribution Methods Manual, 14th Edition (2020)
 - 11. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 - 12. Outside Plant Design Reference Manual, 5th Edition
 - 13. BICSI's ICT Terminology Handbook, Version 1.0
 - 14. Telecommunications Project Management Manual (TPMM), 1st edition
 - 15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 - 16. BICSI's Special ICT Design Considerations, Version 1.0
 - 17. Essentials of Bonding and Grounding, Version 1.0
- F. National Electric Codes
- 1. National Electrical Safety Code (NESC) (IEEE C2-2012)
 - 2. NFPA 70-2020, National Electrical Code® (NEC®)
 - 3. ANSI/IEEE C2-207, National Electrical Safety Code®
 - 4. National Electrical Code (NEC) (NFPA 70)
 - 5. NFPA 72 National Fire Alarm and Signaling Code
- G. ASHRAE
- 1. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings
- H. OSHA Standards and Regulations – all applicable

- I. Local Codes and Standards – all applicable
- J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
- K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
- L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.
- M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.06 EXISTING UTILITIES

- A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.07 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

- A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

- A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.
- D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

- A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.
- B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.
- C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.
- B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor

of

the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

- C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor _____

Signed _____

Position _____

Date _____

*Refer to exception requirements herein.

- D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.
2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be

- coordinated and clearly shown on the Shop Drawings.
3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
 4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.
- E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer's filing convenience.
- F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.
- G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.
- H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
- I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

- A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

- A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.
- B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.
- C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.
- B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

- A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.
- B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.

- C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

- A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.
- B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.
- C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

- 1. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

- A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.
- B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
 - 1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.
- C. The manual shall include the following information
 - 1. Manufacturer's installation instructions.
 - 2. Manufacturer's local representative and/or distributor's name and address.
 - 3. Manufacturer's operating and maintenance instructions.
 - 4. Manufacturer's internal wiring diagrams.

5. Contractor's installation wiring diagrams.
 6. Replacement part number listings and descriptions.
 7. Framed operating instructions, when required, in individual Specification sections.
 8. Warranties and guarantees.
 9. Provide an approved submittal at the front of each section.
- D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
 2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
 3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.
2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.
4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.
3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION 27 00 00

SECTION 27 10 00 – STRUCTURED CABLING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED SECTIONS AND DOCUMENTS

- A. Drawings that are applicable to this section

1.2 DESCRIPTION

- A. Summary of Work:

1. Provide a complete and tested, Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay racks/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
2. Proposed structured cabling must support all current and future standards and data technology.
3. Data, voice, and video cabling will originate in vertical freestanding equipment racks, and/or enclosed vertical wall mounted equipment located in the MDF/IDF locations. Wiring, terminations and patch bays between these designated d-marc points and outlet locations as shown on the plans will be considered part of the contract.
4. All cables and termination will be labeled at all locations.
5. All cables will be labeled according to the College standard (at each location).
6. All copper data cabling will comply with ANSI/TIA/EIA/EIA 568-B standards for Category 6A installations.
7. Acceptable product manufacturers shall provide a complete Category 6A solution.
8. No cable ties, bridle rings, or d rings shall be accepted on the project. Any use of cable ties may require replacement of the entire project cabling at Contractor's expense.
9. Provide AV cabling as shown on the drawings.
10. Cabling will terminate on one, two, or three gang wall plates equipped as shown on the drawings.
11. Prior to installation, the shop drawings shall contain all data drop numbers using the College's MDF/IDF numbering scheme. The owner must sign off shop drawings before any cabling can proceed.
12. Project documentation due upon completion of installation. Documentation includes (but not limited to) all test documentation and all as-builds.
13. The owner reserves the right to be present during installation of all systems. The owner will conduct periodic inspections throughout the construction process.
14. Any loose inventory equipment turned over to the college will require a transmittal sheet when delivered.
15. Contractor will be required to furnish a list (in Excel format) of all data drops listed

by IDF/MDF number, patch panel number, and port number with the associated College assigned room number. (Number scheme listed in Section 3.2 Documentation.)

16. Provide laminated as-built drawings (full sized sheet) for each IDF and provide an addendum as-built drawing (full-sized sheet) for the MDF.

1.3 QUALITY ASSURANCE

A. Acceptable manufacturers:

1. The equipment/products described herein and furnished per these specifications are all Owner preferred products. Substitutions will only be considered when in accordance with SECTION 01 25 00 – SUBSTITUTION PROCEDURES in Division 1.
2. A single manufacturer or teamed manufacturer's certifiable solution except for data racks and other hardware that is not identified, as part of the channel test configuration by ANSI/TIA/EIA 568-B will supply products listed in this section.
3. The approved manufacturer's warranty shall provide a Category 6A solution with a 20-year warranty.
4. Manufacturer will be ISO 9001 Certified with a minimum 7 years' experience in specified products manufacture.
5. Acceptable Category 6A product cable and connectivity shall be a complete end-to-end solution.

B. Installer Qualifications:

1. Structured Cabling System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry.
2. Structured Cabling System Installer shall comply with all federal, state, and local laws.
3. Structured Cabling System Installer shall be certified by the cable manufacturer in all aspects including design, installation, and warranty service of products listed in this document.
4. Structured Cabling System Installer shall provide a list of five (5) similar size projects, a brief description of the project with contact names and phone numbers.
5. Structured Cabling System Installer must have a minimum of 5 years' experience installing structured cabling systems of similar size.
6. Structured Cabling System Installer will use only authorized manufactured components.
7. All on site installers must be employees of the certified Structured Cabling System Installer and at least 25% of the staff must have attended manufacturer provided training. Current certification documents shall be available upon request and included in the Structured Cabling System Installer's product submittals.
8. A Quality Assurance Program with internal inspections to ensure work is performed according to internal as well as industry standards.
9. Structured Cabling System Installer shall own and maintain tools and equipment necessary to properly install fiber optic cabling, Category 6A and Category 3 distribution systems.
10. The College reserves the right to reject any bid of any Structured Cabling System Installer who has previously failed to complete projects properly, on time, or failed to perform properly.
11. The selected, certified system partner that provided pricing, for the scope of work associated with this specification section and associated contract drawings, shall

be the installer of the system. No subcontracting of any portion of this systems scope of work will be allowed beyond the original SCS proposing contractor.

- C. Pre-Construction Meeting:
 - 1. The successful Structured Cabling System Installer will attend a mandatory pre-construction meeting with the project consultant, College technology representative, general contractor, and any other individual deemed necessary by the Owner's representative prior to project start up. Work will not begin until after this meeting.
- D. Acceptance:
 - 1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
 - 1. The selected Structured Cabling System Installer shall be a certified installing contractor of the approved manufacturer's solution and hold current certification. Structured Cabling System Installer shall provide an end-to-end performance warranty of no less than 20-years on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6A cable channels have been tested bi-directionally (end to end) using a Level IIIE tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-B.2-10 and TSB-67 channel values.
 - 2. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.
 - 3. Structured Cabling System Extended Product Warranty and Application Assurance Program Extended Product Warranty: coverage includes product defects for all Data Cable Systems Installer and all installed Structured Cabling System components.
 - 4. The manufacturer's warranty starts the date of project warranty certification issue to the College from the manufacturer.
 - 5. Coverage includes
 - a. All components of the registered SCS to be free from manufacturer defects in material and workmanship under normal and proper use
 - b. All components of the registered SCS will exceed the TIA 568-B.1, B.2, B.3 and exceed ISO/IEC 2nd Edition standards and will confirm to the performance specifications of the manufacturer's associated product data sheet in effect at the time of warranty certification issuance.
 - c. Installation exceeds the requirements of the TIA 568-B and the ISO/11801 2nd Edition Standards for cabling links/channel configurations insertion and return loss, attenuation and near end cross talk for the insertion and return loss, attenuation and near end crosstalk.
 - i. Each channel (All components are manufacturer's Category 6A passive products end-to end) will be capable of delivering 1.0 Gbps to the workstation according to the application standards.
 - 6. Product Warranty, Manufacturer will (at its own expense)
 - a. Repair or replace defective product
 - b. Pay an authorized installer to repair or replace any defective product.
 - c. Replacement parts will be new. No remanufactured or used parts allowed.
 - 7. Structured Connectivity Solutions Extended Product Warranty and Application

Assurance shall be provided at job completion.

1.4 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Latest Local Codes and Amendments
 2. Latest National Electrical Code
- B. Other References:

ANSI/TIA/EIA-568-B.1, COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD (AND ALL PUBLISHED ADDENDA), PART 1: GENERAL REQUIREMENTS, current version.

ANSI/TIA/EIA-568-B.2, COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD (AND ALL PUBLISHED ADDENDA), PART 2: BALANCED TWISTED PAIR CABLING COMPONENTS, current version.

ANSI/TIA/EIA-568-B.2-10 (CURRENT DRAFT), COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD, ADDENDUM 10: TRANSMISSION PERFORMANCE SPECIFICATIONS FOR 4-PAIR AUGMENTED CATEGORY 6A CABLING.

ANSI/TIA/EIA-568-B.3, OPTICAL FIBER CABLING COMPONENTS STANDARD, current version.

NATIONAL FIRE PROTECTION ASSOCIATION, INC., NFPA 70: NATIONAL ELECTRIC CODE (NEC), current version.

1. NEC ARTICLE 250: GROUNDING
2. NEC ARTICLE 386: SURFACE METAL RACEWAYS
3. NEC ARTICLE 388: SURFACE NON-METALLIC RACEWAYS
4. NEC ARTICLE 800: COMMUNICATIONS CIRCUITS
5. NEC ARTICLE 770: OPTICAL FIBER CABLES AND RACEWAY
6. *ANSI/TIA/EIA-569-B*, COMMERCIAL BUILDING STANDARDS FOR TELECOMMUNICATIONS PATHWAYS AND SPACES, current version.
7. *ANSI J-STD-607-A*, COMMERCIAL BUILDING GROUNDING AND BONDING REQUIREMENTS FOR TELECOMMUNICATIONS, current version.
8. *ANSI/TIA/EIA-942*, TELECOMMUNICATIONS INFRASTRUCTURE FOR DATA CENTERS, 2004.
9. *ANSI/ICEA S-83-596*, FIBER OPTIC PREMISES DISTRIBUTION CABLE, current version.
10. *ANSI/TIA/EIA-598*, COLOR CODING OF OPTICAL FIBER CABLES, current version.
11. *ANSI/ICEA S-87-640*, FIBER OPTIC OUTSIDE PLANT DISTRIBUTION CABLE, current version.
12. *ANSI/TIA/EIA-492AAAC*, DETAIL SPECIFICATION FOR 850NM LASER-OPTIMIZED 50UM CORE DIAMETER/125 UM CLADDING DIAMETER CLASS 1A GRADED INDEX MULTIMODE OPTICAL FIBERS, current version.
13. *ANSI/TIA/EIA-492CAAA*, DETAIL SPECIFICATION FOR CLASS IVA DISPERSION-UNSHIFTED SINGLEMODE OPTICAL FIBERS, current version.
14. *ANSI/TIA/EIA-758*: CUSTOMER-OWNED OUTSIDE PLANT TELECOMMUNICATIONS CABLING STANDARD, current version.
15. *ANSI/TIA/EIA-526-7*, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED SINGLEMODE FIBER PLANT: OFSTP-7, current version.
16. *ANSI/TIA/EIA-526-14-A*, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED MULTIMODE FIBER PLANT: OFSTP-14A, current version.

17. TIA/EIA-TSB-125, GUIDELINES FOR MAINTAINING OPTICAL FIBER POLARITY THROUGH REVERSE-PAIR POSITIONING, current version.
18. TIA/EIA-TSB-140, ADDITIONAL GUIDELINES FOR FIELD TESTING LENGTH, LOSS, AND POLARITY OF OPTICAL FIBER CABLING SYSTEMS, current version.
19. UNDERWRITER'S LABORATORY, INC. (UL)
 - a) *UL-5A: Standard for Non-Metallic Raceways and Fittings*
 - b) *UL-5: Standard for Surface Metal Raceways and Fittings*
 - c) *UL-5C: Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits*
 - d) *UL-50: Standard for Enclosures for Electrical Equipment*
 - e) *UL-94-V0: Tests for Flammability of Plastic Materials*
 - f) *UL-498: Attachment Plugs and Receptacles*
 - g) *UL-1479: Fire Tests of Through-penetration Firestops (in Accordance with ASTM E814).*
 - h) *UL-1863: Standard for Safety of Communications Circuit Accessories*
20. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)
 - a) *ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements*
 - b) *NEMA 250-2003: Enclosures for Electrical Equipment*
21. ISO/IEC 11801, ED. 2:2002, INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES, current version.
22. ISO/IEC 18010, INFORMATION TECHNOLOGY – PATHWAYS AND SPACES FOR CUSTOMER PREMISES CABLING, current version.
23. ISO/IEC 14763-1, INFORMATION TECHNOLOGY – IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING – PART 1: ADMINISTRATION, current version.
24. FEDERAL COMMUNICATIONS COMMISSION (FCC) TITLE 47, CODE OF FEDERAL REGULATIONS, PART 68: CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK, current version.
25. ANSI/TIA/EIA-569-B, COMMERCIAL BUILDING STANDARDS FOR TELECOMMUNICATIONS PATHWAYS AND SPACES, current version.
26. ANSI/TIA/EIA-606-A, ADMINISTRATION STANDARD FOR COMMERCIAL TELECOMMUNICATIONS INFRASTRUCTURE, current version.
27. ANSI/EIA-310-D, CABINETS, RACKS, PANELS, AND ASSOCIATED EQUIPMENT, 1992.
28. ANSI/TIA/EIA-604 (SERIES), FOCUS FIBER OPTIC CONNECTOR INTERMATEABILITY STANDARD, current version.
29. U.S. PUBLIC LAW 336. 101ST CONGRESS, ADA: AMERICANS WITH DISABILITIES ACT OF 1992.
30. 802.3af-2003 - IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI).
31. IEEE 802.3AT (CURRENT DRAFT), DATA TERMINAL EQUIPMENT (DTE) ENHANCED POWER OVER MEDIA DEPENDENT INTERFACE (MDI).
32. IEEE 802.3AN-2006 - IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems – LAN/MAN - Specific Requirements Part 3: CSMA/CD Access Method and Physical Layer Specifications - Amendment: Physical Layer and Management Parameters for 10 Gb/s Operation, Type 10GBASE-T
33. IEEE 802.3AE, SPECIFICATION FOR 10 GBIT/S ETHERNET OPERATION OVER OPTICAL FIBER.

34. TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL, 12TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2009.
35. INFORMATION TRANSPORT SYSTEMS INSTALLATION MANUAL, 6TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2010.
- C. Governing Codes and Conflicts:
 1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|------|-------------------------------------|
| DC | Direct Current |
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| PBX | Private Branch Exchange |
| UTP | Unshielded Twisted Pair |
| SCS | Structured Cabling System |
| SCSI | Structured Cabling System Installer |

1.6 SUBMITTALS

- A. Project Initiation:
1. Awarded contractor provides 4 copies of submittal within 14 days of Notice to Proceed
 2. Cover Sheet with Information, Pricing and Materials
 3. Cover sheet
 - a. Company name and logo
 - b. Submittal Title
 - c. Client name
 - d. Business Address
 - e. Point of Contact
 - f. Contact information (phone number)
 4. Product Data
 - a. Manufacturer's catalog information showing (items must be clearly identified in the page (use a red arrow to point to the item)
 - b. All items listed in the "Product's" section of Part 2 and specification sheets for
 - i. All Connectors
 - ii. All termination components for each component type
 - iii. All ground and surge suppression equipment
 - c. Manufacturer's cut sheets for all products with each item clearly identified
 - d. Technical data sheets for showing full swept frequency range of Guaranteed Channel Performance
 - e. Technical data sheets to include physical as well as the following transmission and electrical characteristics
 - i. Wire map
 - ii. Length
 - iii. Insertion Loss
 - iv. Near End Crosstalk
 - v. Power Sum Near End Crosstalk

- vi. Equal Level Far End Cross Talk
 - vii. Power Sum Equal Level Far End Crosstalk
 - viii. Return Loss
 - ix. Propagation Delay
 - x. Delay Skew
- 5. Manufacturer's Instructions
 - a. Application conditions and limitations of use as stipulated by product testing agency's regulatory requirements
 - b. Storage, handling protection, examination, preparation, installation instructions
- 6. Pre-Qualification Certificate
 - a. Documentation showing completion of pre-qualification requirements
 - b. Manufacturer's letter indicating successful completion of pre-qualification requirements
 - c. Certificates for design, engineering, and installation
- 7. Factory Test
 - a. Factory test information submitted prior to installation
 - b. Any substituted products must be verified and justified to be equivalent
 - c. Any and all substitutions will be approved in writing by the Owner.
- 8. Material Guarantee
 - a. Data Cabling System Installer guarantees Category 6A and fiber optic cabling and components meet or exceed ANSI/TIA/EIA-568-B.1, 568-B.2, 568-B.3 and 589 at time of bid.
- 9. Warranty Documentation
 - a. Warranty: life of installed product
 - b. Warranty documentation clearly explains manufacturer's warranty and is included in proposal. A sample warranty is provided with the procedure for processing support requests.
 - c. Application assurance manual which documents the vendor supported applications guidelines will be included in the submittal.
- 10. Test Equipment
 - a. Copper UPT Test Equipment
 - i. Make and Model Number
 - ii. Software version
 - iii. Quantity
 - b. Fiber Optic Test Equipment
 - i. Make and Model Number
 - ii. Software version
 - iii. Quantity
 - c. Submit a current test sample (one per test set)
 - d. Quality Assurance/Control Submittals
 - i. Quality Assurance/Control Submittals
 - ii. Make and Number
 - iii. Software revision
 - iv. Quantity
- B. Shop Drawings:
 - 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Submitted drawings shall indicate the following:
 - 1. Submitted drawings shall indicate the following:
 - 2. SCSI will verify station cabling and MDF-to-IDF routings
 - 3. Location of all wall penetrations (all penetrations shall be sleeved and have protective bushings at both ends)
 - 4. Location of sleeved wall pass-thru
 - 5. Sleeve size at each installed location

6. Cable quantity passing through each sleeve
 7. Location of drop in each room. Room labeling will be according to IDF number, patch panel number, port number
 8. Identify cable routing, size, quantity, and stub-up locations for all floor mounted outlets
 - b. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter.
- C. Close-out Procedures:
 1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion. Manufacturer's representative shall inspect and certify all work to validate the manufacturer's warranty.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document. Test results will be electronic in both native and PDF formats. The software for the native format must be included at no additional cost to the owner.
 - c. Include the Name, address, and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, and a list of recommended spare parts. Spare parts will be included.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity in each raceway. Only blue cabling will be used on this project.
 - g. As-built Drawings shall include cable pathways, circuit termination locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2002 or later. Provide the Owner with electronic versions of the as-builts on CD media in AutoCAD, Visio and PDF format. Also, the as-built drawings are to be posted on laminated sheets in the each MDF/IDF closet for owner's reference.
 - h. A hard copy as well as an electronic copy of the manufacturer's warranty shall be included in the close-out documents.
 - i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during construction, and

shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. This shall include 3 hard and electronic copies in color.

- k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours of training and shall include phone support as needed.
- l. One (1) 30" X 42" laminated floor plan sheets illustrating fiber, copper, technology drops with correct number scheme, and cable designations. Contractor will provide one complete floor plan of each IDF room (to be mounted in each IDF room). The laminated floor plan of the MDF fiber and copper will be an addendum sheet only.

1.7 SPECIFICATIONS

- A. Only Data Cable System Installers certified in the approved manufacturer's solutions are invited to submit bid.
- B. Documentation required for bid response:
 - 1. Certification by manufacturer
 - 2. Certification must be current with eligibility date.
 - 3. Provide a list of current projects that Data Cable System Installer will be working during the same time as this project and the workforce needed at each installation.
 - 4. Data Cable System Installer must submit 3 or more references of projects of similar scope with the following information:
 - a. Size of Project
 - b. Drop count
 - c. Number of wiring closets (MDF/IDFs)
 - d. Total cost of Project
 - e. Services provided
 - f. References must be similar in size and scope
 - g. Document will be submitted within 15 days of Data Cable System Installer selection
 - 5. Provide list of all projects within the last 3 years
 - a. Project location
 - b. Contact information
 - c. Project size
 - d. Approximate budget
 - e. Document will be submitted within 15 days of Data Cable System Installer selection
 - 6. Provide system installation certification covering manufacturer's link/channel specifications for a minimum of 20 years.
 - 7. Provide a sample warranty applicable to the completed project.
 - 8. Provide warranty support processing documentation
 - 9. Provide proof of qualifications with the proposal:
 - a. Technical experience of Project Manager's experience and online supervisor assigned to the project.
 - b. Project Manager will have 5 years' experience on projects of similar size and scope
 - c. Project Foreman will have 3 years minimum project experience working crews of 4 or more.
 - d. List of product-related training attended by Data Cable System Installer staff.

- C. Workers on site are employees of the Data Cabling System Installer. Every employee will be properly trained by the manufacturers of the installed products.

1.8 CABLING REQUIREMENTS

- A. A. Cable Pathway
1. All network cabling that is concealed in walls and exposed above ceiling grid level in plenum spaces:
 - a. Shall be in conduit installed by the electrical contractor with nylon bushings.
 - b. Cable tray and J-Hook method of delivery system, which is provided and installed by the Data Cabling System Installer.
 2. Conduits are to be free of dirt and debris prior to cable installation.
 - a. Failure to clean out debris results in replacing cabling at Data Cabling Installer's sole expense.
 3. Velcro straps are not a suitable method to change the direction of a cable bundle.
 4. Cable trays shall exit the cable trays vertically using cable drop assemblies or "waterfalls" at all times. Cables that are not properly dressed which turn vertically over right angles or wire baskets will be in violation of bend radius requirements.
 5. Cabling that violates the bend radius rule will be replaced at Data Cabling System Installer's expense.
 6. *No plastic tie wraps are allowed* for use in structured pathway cabling.
 7. All cabling found bundled by plastic tie wraps will be replaced at Data Cabling System Installer's expense.
- B. Hardware
1. A complete and functioning system requires hardware including (but not limited) to UTP cabling, fiber backbone, patch panels, fiber termination sleeves, equipment racks, cable trays, ladder racks, vertical wire management, termination blocks, data and voice outlets, connectors, fiber and copper patch cables, and all other accessories needed to provide a complete and functioning system.
 2. All outlets (both copper and fiber) must be protected from construction related dust. Outlets not protected will be replaced at Data Cabling System Installer's expense.
 3. Dust proof barriers will remain in place after the final testing phase is complete.

1.9 GROUNDING AND BONDING

- A. All grounding and bonding will be according to National Electrical Code and any local codes pertaining to grounding and bonding requirements.
- B. Bonding and Grounding
1. Bonding and Grounding will adhere to 607-Standards.
 2. Communication bonding and grounding will be according to the National Electrical Code and the National Fire Protection Association.
 3. Horizontal Cabling will be according to ANSI/NFPA 70 as well as any local requirements and practices.
 4. Horizontal equipment includes cross connect frames, patch panels, racks, active telecommunication equipment and test apparatus and equipment.
 5. Where directed by local code, provide a Telecommunication Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding between equipment rooms and telecommunications rooms.
 6. Note: this is part of the grounding and bonding infrastructure (telecommunications pathways and spaces within the building structure) and is independent of any equipment or cable.

1.10 SPECIAL REQUIREMENTS FOR CABLING ROUTING AND INSTALLATION

- A. Cabling
 - 1. All communications cabling used shall comply with the NEC Articles 725, 760, 770, 800 as well as the relative local codes
 - 2. All copper cabling has the applicable markings for the installed environment.
 - 3. All fiber optic cabling has the applicable markings for the installed environment.
- B. Cable Pathways
 - 1. Data Cable Systems Installer coordinates cable placement with the General Contractor during the painting phase of the construction in order to avoid paint on the cabling. Note: If Data Cable System Installer fails to coordinate with the General Contractor, any cables that get coated with paint will be replaced at Data Cable System Installer's sole expense.
 - 2. Required cable bundle placement in shared pathways is noted on the drawings.
 - 3. In suspended ceilings and other areas where duct, cable trays or conduit are not available, Contractor will bundle (maximum of 48) station wiring using Velcro straps snug so as not to deform the cable geometry.
 - 4. Cables will be supported by "J" hooks and/or saddles/slings securely attached to existing building structure and framework no greater than five (5) foot intervals.
 - 5. Bundle cables in pathways with Velcro only. Cable ties are not permitted on any cable at any time. This includes both installation and post-installation phase.
 - 6. Data Cable System Installer will strictly follow Manufacturer's bend radius as well as cable pulling tension requirements.
 - 7. No cabling should be attached to lift out ceiling grid supports or laid directly on ceiling grid or tiles.
 - 8. No cabling to be attached to or supported by the fire sprinkler system including the heads or delivery system.
 - 9. No cabling to be attached to or supported by any environmental sensors in ceiling air space or duct work.
 - 10. Cables found violating the above requirement will be removed, pathway corrected, and then cable reinstalled at Data Cable System Installer's sole expense.
- C. All data ports and outlets must be always protected from contaminants such as dust and debris. Fire Stopping
 - 1. Equipment and practices must comply with applicable national and local codes.
 - 2. Data Cabling Systems Installer responsible for sealing all cable pass through in walls rated fire rated and smoke, and any openings created between floors.
 - 3. Proper sealing is required. Sealing material and material application must be acceptable to local fire and building authorities as well as authorities having the highest jurisdiction.
 - 4. Data Cabling System Installer is responsible for creating only those openings as is necessary for cable passage between locations shown on the drawings.
 - 5. All openings created by Data Cabling System Installer must be sealed.
- D. Data Cable System Installer Responsibility (Sole Expense)
 - 1. Data Cable System Installer is responsible for damage to any surface or work disruption caused by him. (Any repairs including but not limited to surface repair or painting will be included as deemed necessary.)
 - 2. Data Cable System Installer will make restitution for all damages caused by his work.

1.11 SPECIAL REQUIREMENTS FOR CABLING ROUTING AND INSTALLATION

- A. Horizontal Cabling
 - 1. Data Cable System Installer supplies the cabling to connect outlet to the backbone subsystem on same floor.

2. The type horizontal cabling used for each work location will be 4-pair UTP unless otherwise noted.
3. The College utilizes star topology from the wiring closets to the outlet.
4. The length of each individual run will not exceed 290 feet.
5. Cable to be installed according to manufacture instructions as well as Category 6A industry standards.
6. Any cabling found in violation of any standards listed in this document will be replaced at Data Cable System Installer's sole expense.
7. Contactor will coordinate with electrical contractor for final pathways.
8. All cable routes to be approved by the Architect and the College prior to cable installation.
9. During initial cable installation (rough-in), cable shall be always protected.
 - a. Cable will not be left on the floor.
 - b. Cable will be protected in open boxes, slings that are properly used, and approved barricades.
 - c. Cable shall NOT be suspended by tie wraps or any other method that can compromise the integrity of the cable.
 - d. Wide-base support systems must be used (according to bundle size) to support cable during the rough-in.
 - e. Any cable not handled properly or protected and deemed damaged will be replaced at Data Cable System Installer's sole expense.
10. Data Cable System Installer shall not install cable in any conduit prior to the installation of conduit bushings.
 - a. Electrical contractor will furnish and install conduit bushings on all low voltage conduits.
 - b. Anticipated cable installation delays caused by conduit bushings that installed will should be immediately brought to the attention of the General Contractor and Architect.
 - c. Cable that is installed in conduits without bushings will be replaced at the Structured Cabling System Installer's expense.
 - d. No installation of conduit bushings after the cable is pulled through the conduit is acceptable.
11. Recommended radius bend and pulling strength requirements for 4-pair UTP will be always observed during handling and installation.
 - a. Avoid bending bends that deform cable jacket.
 - b. Push slack cable above the ceiling level to avoid radius violations in the in back box.
 - c. Cables leaving J-Hooks to conduit stubs requires a gradual sweep and not have sharp turns.
12. Each cable run from the patch panel to the room outlet will be continuous without any joints or splices.
13. Cable runs should not be run in electrical rooms.
14. Cable runs shall not run parallel to electrical pathways without proper separation.
15. In areas where cable trays or conduit is not available, station cables will be bundled with Velcro straps at appropriate distances (no sagging).
 - a. Cable will be supported by J-Hooks attached to the existing building structure and framework.
 - b. Do not mix different types of transmission media in the same J-Hook. For example, Fiber optic cable and Category 6A may not be mixed.
16. Cables are not supported by duct work.
17. Building support system are not acceptable supports. Cables should not wrap around the building structure.
18. Horizontal cabling will be concealed in interior walls. If obstructions exist, approval must be obtained from the Architect and owner prior to the use of an alternate method.

19. Any damage to the ceiling grid or tiles caused by the cabling contractor will be paid for by the cabling contractor.
20. All 4-pair UTP cabling will be UL rated.
21. Conduit installed by Data Cabling Installation contractor will not exceed 100 feet or have more than two 90° (90 degree) bends without the use of pull boxes. The Architect must approve the configuration.
22. All station cables and tie cables will be run at right angles to electrical power circuits.

PART 2 – PRODUCTS

2.1 EQUIPMENT RACKS

- A. 2-Post Open Frame Racks
 1. Design Make shall be:
 - a. CPI (Chatsworth Product Inc.)
- B. 4-Post Open Frame Racks
 1. Design Make shall be:
 - a. CPI (Chatsworth Product Inc.)
- C. Wall Mount Network Enclosure
 1. Design Make shall be:
 - a. CPI (Chatsworth Product Inc.)

2.2 VERTICAL CABLE MANAGEMENT

- A. Vertical Cable Management for Racks/Frames
 1. Every rack/frame shall have two vertical cable managers. The vertical cable manager shall create a space for storing and organizing cables along the side of the rack/frame. The cable manager shall maintain separation between patch/equipment/jumper cords and premise cables.
 2. The vertical cable manager shall match the height of the rack(s)/frame(s).
 3. The vertical cable manager shall bolt to the side of racks/frames with included hardware.
 4. Design Make shall be:
 - a. CPI (Chatsworth Product Inc.)
 - b. Single-Sided Vertical Cable Management, 10.25" Wide x 84" Long. Black Hinge Cover.

2.3 HORIZONTAL CABLE MANAGEMENT

- A. Horizontal Cable Management for Racks/Frames – **See installation instructions in section 3.5.**
 1. Design Make shall be:
 - a. CPI (Chatsworth Product Inc.)
 - b. Single-Sided Horizontal Cable Manager, 1U x 19" Wide, Black.

2.4 LADDER RACK, SUPPORTS, AND ACCESSORIES

- A. Ladder Rack

1. Design Make:
 - a. CPI (Chatsworth Product Inc.)
 - b. Ladder Rack, 12" (457 mm) Wide, Black.
- B. The cabling contractor shall provide and install all CPI (Chatsworth Product Inc.) ladder racks, supports, and accessories to ensure a complete and functional system that is properly bonded and grounded.

2.5 J-HOOKS

- A. The J-Hooks will have a wide base design and smooth beveled edges to provide a large bending radius for current and future high-performance data cables and fiber optics.
- B. J-Hooks offer a solution that meets industry standards for Cat 6A and easily accommodates large-diameter fiber optic, inner duct, and coax cable.
- C. The J-Hooks are designed to provide a strong and stable pathway support installation.
- D. Provides optimal support for high-performance data cable, up to and including Cat 5e, Cat 6, Cat 6A, and fiber optic cables
- E. Rounded edges on J-Hooks provide proper bend radius support for high performance data cables
- F. Multiple color options aid in the identification and organization of the pathway application
- G. Provides superior fill capacity and load rating over most other non-continuous cable support alternatives
 1. Category 5e – 50 Cables
 2. Category 6 – 35 Cables
 3. Category 6A – 25 Cables
- H. Compliant with UL® 2043 and suitable for use in air handling (plenum) spaces
- I. J-hooks do not require to be grounded
- J. Meets ISO®/IEC 14763-2, ANSI/TIA 568 and ANSI/TIA 569
- K. Erico/Caddy Cat 32

2.6 CONDUIT SYSTEMS

- A. Conduit
 1. Approved manufacturers
 - a) for galvanized rigid conduit (GRC), intermediate metallic conduit (IMC), and electrical metallic tubing (EMT) are
 - 1) Triangle
 - 2) Allied
 - 3) Wheatland.
- B. Datacom/AV/Electrical box
 1. Gangable AV Wall Boxes are a solution for in wall applications requiring AV, data and power integration.
 2. Concentric 1"- 2" knockouts combined with a 4-inch depth facilitate easy installation of AV cables incorporating pre-connectorized heads and bend radii required for high performance Category 6A and 6A cables.
 3. Designed to be installed independently or ganged together to receive any number of devices, allowing them to accept any standard wall plate.
 4. The Gangable AV Wall has a built-in adjustable sheetrock locating bracket to adjust to the depth of the sheetrock.
 5. The Gangable AV Wall can be installed in 2, 3, 4, 5, 6 gang applications.
 6. A ground screw available in each gang so that regardless of what services are brought into the box there is a means of grounding readily available.
 7. The metallic low voltage partition is available to separate electrical from low voltage and can be use used to divide other low voltage applications.

8. A metallic low voltage partition is available for both boxes and is adjustable to accommodate any number of gangs.
9. Approved manufacturer of Datacom/AV/Electrical box is:
 - a) 2 gang – Hubbell HBL985
 - b) gang – Hubbell HBL986

2.7 FIBER CABLING – BACKBONE

- A. Multimode Optical Fiber Cable: **USED FOR ALL OTHER BACKBONE CONNECTIONS**
 1. 24-fiber, Tight-Buffered, OM3 Multimode, Premises Distribution Indoor/Outdoor Plenum Cable with Interlocking Armor, Part Number: Leviton Manufacturer
 - a. Part Number: Berk-Tek PDPK012FB3010/F5-I/O-C4C5(AQU).
 - b. Coordinate strand count with Owner prior to installation
 - c. Or Owner approved equal.
- B. Single mode Optical Fiber Cable:
 1. 24-fiber, Tight-Buffered, OS2 Single mode, Premises Distribution Indoor/Outdoor Plenum Cable with Interlocking Armor
 - a. Part Number: Berk-Tek PDPK012AB0707-I/O-C4C5(YEL).
 - b. Coordinate strand count with Owner prior to installation
 - c. Or Owner approved equal.

2.8 COPPER CABLING – BACKBONE

- A. Fused Telecom Building Entrance Terminal:
 1. Building Entrance Terminal (Indoor), IDC style 66 Block input and output, 50-Pairs
 - a. Part Number: Circa 2650QC/QC.

2.9 FIBER OPTIC TERMINATION ENCLOSURES and SPLICE TRAYS.

- A. 1000i SDX 1RU Distribution and Splice Enclosure, empty, with sliding tray.
 - a. Accepts up to (3) SDX adapter plates or (3) SDX MTP cassettes and accepts up to (3) splice trays.
 - b. Part Number: Leviton 5R1UM-S03.
- B. 1000i SDX 2RU Distribution and Splice Enclosure, empty, with sliding tray.
 - a. Accepts up to (6) SDX adapter plates or (6) SDX MTP cassettes and accepts up to (6) splice trays.
 - b. Part Number: Leviton 5R2UM-S06.
- C. 1000i SDX 4RU Distribution and Splice Enclosure, empty.
 - a. Accepts up to (12) SDX adapter plates or (12) SDX MTP cassettes and accepts up to (12) splice trays.
 - b. Part Number: Leviton 5R4UM-F12.

2.10 FIBER OPTIC ADAPTER PLATES

- A. SDX Precision Molded Plate (AQUA), Use for OM3/4 Fiber Optic System.
 - a. 50/125um Multimode Laser Optimized OM3/4, Duplex LC, 12 fibers, Zirconia Ceramic Sleeve
 - b. Part Number: Leviton 5F100-2QL.
- B. SDX Precision Molded Plate (AQUA), Use for OM3/4 Fiber Optic System.
 - a. 50/125um Multimode Laser Optimized OM3/4, Quad LC, 24 fibers, Zirconia Ceramic Sleeve
 - b. Part Number: Leviton 5F100-4QL.
- C. SDX Precision Molded Plate (BLACK)

- a. Adapter Plate, blank
 - b. Part Number: Leviton 5F100-PLT
 - c. Blanking plates shall be installed in any unused fiber enclosure openings.
- D. OM3/OM4 Fiber Optic Connectors (aqua): Use for OM3/OM4 Fiber Optic System.
 - a. FastCAM Pre-polished Connector, LC (aqua), 50/125µm Laser Optimized Multimode
 - b. Part Number: Leviton 49991-LLC

2.11 PATCH CORDS/JUMPERS

- A. OS1/OS2, yellow. Factory-terminated, double-ended, 2-strand multimode cordage, UPC polish. Use for OS2 Fiber Optic System
 - a. 9/125 µm Single-mode (OS2) OFNR
 - b. Duplex LC-Duplex LC:
 - 1) Part Number: Leviton UPDLC-S01 (1 meter)
 - 2) Part Number: Leviton UPDLC-S02 (2 meter)
 - 3) Part Number: Leviton UPDLC-S03 (3 meter)

2.12 STATION CABLING – WORK AREA OUTLETS

- A. **MANUFACTURERS**
 - 1. **Berk-Tek, a Leviton Company 132 White Oak Road, New Holland, PA 17557, Phone: 800-237-5835, Website www.berktek.us.**

2.13 STATION CABLING – WORK AREA OUTLETS

- A. Category 6A Unshielded Twisted Pair:
 - 1. 100-ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, LM-RDT, CMP rated.
 - a. Color: Blue. For all Data Cables.
 - b. Part Numbers: Reel: 11141650
 - c. Maximum Cable Diameter: 0.230 inch.
 - d. Berk-Tek LM-RDT CMP
 - e. Or Owner approved equal.
- B. Category 6A Modular Jacks:
 - 1. Leviton 8-position eXtreme QuickPort modular jack, Category 6A, IDC terminals, T568A/B wiring scheme.
 - a. Color: blue.
 - b. Each Connector: Identified on its face as CAT 6A.
 - c. Part Number: Leviton 6110G-RL6 (blue). For security/access control applications.
 - d. Or Owner approved equal.
- C. Leviton Category 6A Modular Patch Cords:
 - 1. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Red
 - b. Part Numbers:

- 1) Leviton 6AS10-07R (7 feet, Red). For Fire or security/access control applications at device end.
 - 2) Leviton 6AS10-10R (10 feet, Red). For Fire or security/access control applications at device end.
 - 3) Leviton 6AS10-15R (15 feet, Red). For Fire security/access control applications at device end.
 - c. Or Owner approved equal.
 2. High-flex Small Diameter, 28-gauge, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Blue.
 - b. Part Numbers:
 - 1) Leviton H6A10-07L (7 feet, Blue). For Data applications at patch panel end.
 - 2) Leviton H6A10-10L (10 feet, Blue). For Data applications at patch panel end.
 - 3) Leviton H6A10-15L (15 feet, Blue). For Data applications at patch panel end.
 - c. Note: When using 28-gauge patch cords, derate the total channel length according to the chart in Appendix 1 at the end of this section.
 - d. Or Owner approved equal.
 3. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Green.
 - b. Part Numbers:
 - 1) Leviton 6AS10-07G (7 feet, Green). For voice/data applications at user end.
 - 2) Leviton 6AS10-10G (10 feet, Green). For voice/data applications at user end.
 - 3) Leviton 6AS10-15G (15 feet, Green). For voice/data applications at user end.
 - c. Or Owner approved equal.
 4. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - d. Color: Yellow.
 - e. Part Numbers:
 - 1) Leviton 6AS10-07Y (7 feet, Yellow). For Wireless/AP applications at user end.
 - 2) Leviton 6AS10-10Y (10 feet, Yellow). For Wireless/AP applications at user end.
 - 3) Leviton 6AS10-15Y (15 feet, Yellow). For Wireless/AP applications at user end.
 - f. Or Owner approved equal.
- D. Cat 6A Patch Panels:
1. Leviton Cat 6A Flat 110-Style Patch Panel, 1RU, 24-Port, with 1 cable management bar.
 - a. Part Number: Leviton 6A586-U24.
 2. Leviton Cat 6A Flat 110-Style Patch Panel, 2RU, 48-Port, with 2 cable management bars.
 - a. Part Number: Leviton 6A586-U48.
 - b. Or Owner approved equal.
- E. Cable Management Clip:
1. Cable management clip, gray.
 - a. Part Number: Leviton 49005-CMC.
 - b. For cable management on the rear of every patch panel.
 - c. 1RU patch panels require 1 cable management clip.

- d. 2RU patch panels require 2 cable management clips.
- e. Or Owner approved equal.

F. Flush-Mounted Stainless-Steel Faceplates:

- 1. 1-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L1.
- 2. 2-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L2.
- 3. 4-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L4.
- 4. 6-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L6.
- 5. 4-port QuickPort dual-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-2L4.
- 6. 8-port QuickPort dual-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-2L8.

2.14 STATION CABLING – WIRELESS ACCESS POINTS

A. Category 6A Unshielded Twisted Pair:

- 1. 100-ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, LM-RDT, CMP rated.
 - a. Color: Green. For Voice/Data Applications.
 - b. Part Numbers: Reel: 11142235
 - c. Maximum Cable Diameter: 0.300 inch.
 - d. Berk-Tek LM-RDT CMP
 - e. Or Owner approved equal.

B. Category 6A Modular Jacks:

- 1. Leviton 8-position eXtreme QuickPort modular jack, Category 6A, IDC terminals, T568A/B wiring scheme.
 - a. Color: green.
 - b. Each Connector: Identified on its face as CAT 6A.
 - c. Part Number: Leviton 6110G-RV6 (green). For Voice/Data Applications.
 - d. Or Owner approved equal.

C. In-Ceiling Bracket:

- 1. In-Ceiling Bracket, with clip for drop wire/rod mounting.
 - a. Part Number: Leviton 49223-CBC. For wireless applications.
 - b. Brackets must be installed on a dedicated drop wire/rod per NEC® 300.11
 - c. Compatible with QuickPort Surface-Mount Boxes (fasteners included with bracket, boxes sold separately)

D. Surface Mount Box:

- 1. Surface Mount Box, 1-port, standard depth.
 - a. Color: white.
 - b. Part Number: Leviton 41089-1WP. For wireless applications.
 - c. Brackets must be installed on a dedicated drop wire/rod per NEC® 300.11

- d. Compatible with QuickPort Surface-Mount Boxes (fasteners included with bracket, boxes sold separately)
- E. Cat 6A Patch Panels:
 - 1. Leviton Cat 6A Flat 110-Style Patch Panel, 1RU, 24-Port, with 1 cable management bar.
 - a. Part Number: Leviton 6A586-U24.
 - 2. Leviton Cat 6A Flat 110-Style Patch Panel, 2RU, 48-Port, with 2 cable management bars.
 - a. Part Number: Leviton 6A586-U48.
 - b. Or Owner approved equal.
- F. Cable Management Clip:
 - 2. Cable management clip, gray.
 - a. Part Number: Leviton 49005-CMC.
 - b. For cable management on the rear of every patch panel.
 - c. 1RU patch panels require 1 cable management clip.
 - d. 2RU patch panels require 2 cable management clips.
- G. OM3, aqua. Factory-terminated, double-ended, 2-strand multimode cordage. Use for OM3 Fiber Optic System
 - a. 50/125 μ m LOMM (OM3) OFNR
 - b. Duplex LC-Duplex LC:
 - 1) Part Number: Leviton 5LDLC-M01 (1 meter)
 - 2) Part Number: Leviton 5LDLC-M02 (2 meter)
 - 3) Part Number: Leviton 5LDLC-M03 (3 meter)
- A. Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant
 - 2. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant
- B. Firestop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty
- C. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows
- D. Fire-Rated Cable Grommet: STI SpecSeal® Brand Firestop Grommet is a molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.
 - 1. Specified Technologies Inc. (STI) SpecSeal® Brand Ready® Firestop Grommets; RFG1.

- E. Fire-Rated Cable Pathways: STI EZ-PATH® Fire-Rated Pathway device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH® Fire Rated Pathway
- F. Smoke and Acoustical Pathways: STI EZ-PATH® Smoke & Acoustical Pathway device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH® Smoke & Acoustical Pathway; Model No. NEZ33.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive communications horizontal cabling.
- B. Notify Architect of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION – GENERAL

- A. Install communications horizontal cabling in accordance with manufacturer's instructions, ANSI/TIA-568-D.0, ANSI/TIA-568-D.1, ANSI/TIA-569-D, BICSI TDM, and NFPA 70.
- B. Field Terminated Copper and Fiber Optic Patch Cords and Jumpers: Not allowed.
- C. Copper Patch Cords and Fiber Jumpers: Manufactured by Leviton Network Solutions.
- D. Install cables after building interior has been physically protected from weather and mechanical work likely to damage cabling has been completed.
- E. Ensure cable pathways are completely and thoroughly cleaned before installing cabling.
- F. Inspect installed conduit, wireway, cable trays, and innerduct.
- G. Clean additional enclosed raceway and innerduct systems furnished.
- H. Provide protection for exposed cables where subject to damage.
- I. Abrasion Protection:
 - 1. Provide abrasion protection for cable or wire bundles which pass through holes or across edges of sheet metal.
 - 2. Use protective bushings to protect cables.
- J. Cable Ties and Other Cable Management Clamps:
 - 1. No more than hand tightened.
 - 2. Fit snugly, but not compress, crimp, or otherwise change physical characteristics of cable jacket or distort placement of twisted-pair components.
 - 3. Replace cables exhibiting stresses due to over tightening of cable management devices.
 - 4. Velcro wraps are required for all cable bundles. Plastic cable ties are strictly prohibited.
- K. Where possible, route cables in overhead cable trays and inside wire management systems attached to equipment cabinets and racks.
 - 1. Use Velcro or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
 - 2. Cable Trays: Do not exceed 50 percent fill.
- L. Pull Cord:
 - 1. Nylon, 1/8-inch minimum.
 - 2. Co-install with cables installed in conduit.
- M. Cable Raceways: Do not fill greater than ANSI/TIA-569-D maximum fill ratio for each raceway type.
- N. Support horizontal cables at a maximum of 48-inch (1.2 to 1.5-m) irregular intervals if J-hook or trapeze system is used to support cable bundles.

- O. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits.
- P. Bundle horizontal distribution cables in groups of no more than number of cables designed for by cable support manufacturer, based on cable OD and weight.
- Q. Fire-Sprinkler System:
 - 1. Install cables above fire-sprinkler system.
 - 2. Do not attach cables to fire-sprinkler system or ancillary equipment or hardware.
 - 3. Install cable system and support hardware so that it does not obscure valves, fire alarm conduit, boxes, or other control devices.
- R. Do not attach cables to ceiling grid or lighting fixture wires.
- S. Install appropriate carriers to support cabling, where support for horizontal cables are required.
- T. Replace before final acceptance, cables damaged or exceeding recommended installation parameters during installation.

3.3 INSTALLATION – UNSHIELDED TWISTED-PAIR CABLES

- A. Install unshielded twisted-pair cables in accordance with manufacturer's instructions.
- B. Install cables in continuous lengths from origin to destination, without splices, except for transition points or consolidation points.
- C. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for the purpose.
- D. Cable Minimum Bend Radius and Maximum Pulling Tension:
 - 1. Do not exceed bend radius for UTP = 4 X Cable OD, FTP = 4 X Cable OD.
 - 2. Install unshielded twisted-pair cables so that there are no bends smaller than 4 times cable outside diameter at any point in the run and at the termination field.
 - 3. Pulling Tension on 4-Pair UTP Cables: Do not exceed 25 ft.lb. for 4-pair UTP cable.
- E. Separation from Power Lines: Provide following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
 - 1. Open or Nonmetal Communications Pathways:
 - a. Electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA: 12 inches.
 - b. Electrical equipment and unshielded power lines carrying more than 5 kVA: 36 inches.
 - c. Large electrical motors or transformers: 48 inches.
 - 2. Grounded Metal Conduit Communications Pathways:
 - a. Electrical equipment and unshielded power lines carrying up to 2 kVA: 2-1/2 inches.
 - b. Electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA: 6 inches.
 - c. Electrical equipment and unshielded power lines carrying more than 5 kVA: 12 inches.
 - d. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA: 3 inches.
 - e. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying more than 5 kVA: 6 inches.

3.4 INSTALLATION – UNSHIELDED TWISTED-PAIR TERMINATION

- A. Coil cables to house cable coil without exceeding manufacturer's bend radius.
 - 1. In hollow wall installations where box eliminators are used, store excess wire in wall.
 - 2. Store no more than 12 inches of UTP and 36 inches of fiber slack.
 - 3. Loosely coil excess slack and store in ceiling above each drop location when there is not enough space present in outlet box to store slack cables.
- B. Dress and terminate cables in accordance with ANSI/TIA-568-D.0, ANSI/TIA-D.1, BICSI TDDMM, and manufacturer's instructions.
- C. Terminate 4-pair cables on jack and patch panels using T568-B or T568-A wiring scheme.

- D. Pair Untwist at Termination: Do not exceed 12.7 mm (1/2 inch) for Cat 6 and 6.4 mm (1/4 inch) for Cat 6A.
- E. Bend Radius of Horizontal Cables:
 - 1. Not less than 4 times OD of UTP cables.
- F. Maintain cable jacket to within 12.7 mm (1/2 inch) of termination point.
- G. Neatly bundle cables and dress to their respective panels or blocks.
 - 1. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame.

3.5 INSTALLATION – RACK ELEVATION AND PATCH PANEL INSTALLATION

- A. In each IDF/MDF the cables will be installed on the patch panels by the use of the cable. The reasoning behind this is to assist in improving security on the switch side, more effective cable management, and align cabling with switches for better device management.
 - 1. Smart-TV cables sequentially align on the same patch panel (Leave 4 open ports for growth)
 - 2. Clock cables will sequentially align on the same patch panel (Leave 4 open ports for growth)
 - 3. Security camera and Alarm cables will sequentially align on the same patch panel (Leave 4 open ports for growth)
 - 4. WAP device cables will sequentially align on the same patch panel (Leave 4 open ports for growth)
 - 5. Teacher drop cables will sequentially align on the same patch panel (Leave 4 open ports for growth)
 - 6. Student drop cables will sequentially align on the same panel (Leave 4 open ports for growth)
- B. Patch panels will be placed into the following order
 - 1. 24 port patch panel at the top
 - 2. Leave a space for 48 port Switch
 - 3. 48 port patch panel
 - 4. Leave a space for 48 port Switch
 - 5. Repeat till end with 24 port patch panel at the bottom
 - 6. In the middle of this layout of patch panel and switch put a 1U cable management rack
- C. Note: The IDF on the second floor in area D will have cables from both floors pulled to it. The first-floor cabling will be terminated in one rack and the second floor cabling in another.

3.6 INSTALLATION – OPTICAL FIBER CABLES

- A. Place fiber optic cables to maintain minimum cable bend radius limits specified by manufacturer or 15 times cable diameter, whichever is larger.
- B. Use care when handling fiber optic cables.
 - 1. Carefully monitor pulling tension so as not to exceed limits specified by manufacturer.
- C. Do not splice horizontal fiber optic cables.

3.7 FIELD QUALITY CONTROL

- A. Cables and Termination Hardware: Test 100 percent for defects in installation and verify cabling system performance under installed conditions in accordance with ANSI/TIA-568-D.0.
 - 1. Verify all pairs of each installed cable before system acceptance.

2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
- B. Test all cables in accordance with this specification section, ANSI/TIA-568-D.2, and ANSI/TIA-568-D.3 standards, and Berk-Tek Leviton Technologies instructions.
 1. If any of these are in conflict, bring discrepancies to the attention of the Architect for clarification and resolution.
- C. Cables, Jacks, Connecting Blocks, and Patch Panels:
 1. Verify all pairs of each installed cable before system acceptance.
 2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
- D. Testing Unshielded Twisted-Pair Cables: **(NOTE: Permanent Link Test results are recommended and are the expected norm.)**
 1. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
 - a. Additional testing is required to verify Category performance.
 - b. Test horizontal cabling using approved certification tester for Category 6A performance compliance in accordance with ANSI/TIA-568-D.2.
(NOTE: Appropriate Fluke, Agilent, Ideal, or JDSU certification testers may be used).
 - c. Category 6A shall conform to ANSI/TIA-568-D.2 for augmented Category 6 to 500 MHz.
 2. Follow ANSI/TIA-568-D.2.
 3. Basic Tests Required:
 - a. Wire map.
 - b. Length (feet).
 - c. Insertion loss (dB), formerly attenuation.
 - d. NEXT (Near end crosstalk) (dB).
 - e. Return loss (dB).
 - f. ELFEXT (dB).
 - g. Propagation delay (ns).
 - h. Delay skew (ns).
 - i. PSNEXT (Power sum near-end crosstalk loss) (dB).
 - j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB).
 4. Test Category 6A by auto test to 500 MHz.
 - a. Alien Crosstalk (AXT) testing and AXT test results are NOT required by Berk-Tek Leviton Technologies for warranty of a Category 6A system. **(Note:** AXT testing may be required by the customer, in which case these tests WOULD have to be performed).
 5. Test Category 6 by auto test to 250 MHz.
 6. Test Category 5e by auto test to 100 MHz.
 7. Provide test results in approved certification testers original software format on CD, with the following minimum information per cable:
 - a. Circuit ID.
 - b. Information from specified basic tests required.
 - c. Test Result: "Pass" or "Fail".
 - d. Date and time of test.
 - e. Project name.
 - f. NVP.
 - g. Software version.
 8. An occasional asterisk-Pass (*Pass) will be accepted by Berk-Tek Leviton Technologies at the manufacturer's discretion, but rework of these links should be done to achieve clean "Pass" results prior to submission of test results.

9. To receive Manufacturer's Warranty for the project, submit software copy of test results, in original tester software format, to the Owner and to the Manufacturer (Leviton Network Solutions).
 10. Submit fully functional version of tester software for use by the Owner in reviewing test results.
 11. Report in writing to the Owner immediately, along with copy of test results, failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs).
- E. Optical Fiber:
1. Testing procedures shall be in accordance with the following:
 - a. ANSI/TIA-568-D.3
 - b. ANSI/TIA-526-7
 - c. TIA TSB-140
 - d. Encircled Flux testing per the TSB-4979 and TIA-526-14-C standard.
 2. Test Equipment: Certification tester (Note: Fluke or Agilent testers may be used).
 3. Testing:
 - a. Test optical fibers at both 850 nm and 1300 nm wavelengths for multimode, 1310 nm and 1550 nm wavelengths for singlemode, end-to-end insertion loss, Telecommunications Room (TR) to Telecommunications Outlet (TO), Telecommunications Outlet (TO) to Telecommunications Room (TR).
 - b. Maximum insertion loss for horizontal fiber optic cables without consolidation point: 2.0 dB.
 - c. Test horizontal fiber runs TR to TO, TO to TR, at wavelength of operation to desktop applications.
 4. Submit software copy of test results, in original tester software format, to the Owner and to the Manufacturer (Leviton Network Solutions).

3.8 LABELING

- A. Self-laminating or wrap-around style labels shall be used for horizontal cabling.
- B. All labeling is to be in accordance with ANSI/TIA-606-C and manufacturer's instructions.
- C. Label horizontal cables using machine-printed label at each end of cable at approximately 12 inches from termination point and again at approximately 48 inches from termination point.
 1. Handwritten Labels: Not acceptable.
- D. Label patch panel ports and TO ports with cable identifier.
- E. Labels:
 1. Owner may provide specific labeling requirements. Coordinate with the Owner.
- F. Note labeling information on as-built drawings.
- G. Typical Patch Panel Labeling
- H. Typical Wallplate Labeling

3.9 PROTECTION

- A. Protect installed communications horizontal cabling from damage during construction.

END OF SECTION 27 10 00

SECTION 27 41 13 – AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide all equipment specified well as all miscellaneous parts and materials required for the proper installation of the sound reinforcement system. Any alternates must be approved in writing by architect and maintenance.
- B. All applicable equipment shall bear the UL label.
- C. Contractor shall have been in the professional pro-audio business for at least five or more years. Contractor shall have installed at least five or more equivalent systems within the county areas.
- D. Integrate the local sound reinforcement system with the following systems:
 - 1. Local Area and District Wide Network – data drop by Technology cabling contractor
 - 2. Fire alarm system – Fire alarm Module and Wiring by Fire alarm Contractor
- E. Refer to Section Div 26 for raceway specification and general requirements.
- F. Provide one data outlet to nearest MDF rack.
- G. Electrician shall be responsible for all raceway and will coordinate with sound contractor prior to installation.
- H. Electrician shall provide dedicated 20-amp 120-volt circuit with ground.
- I. Systems to be installed in the following Area's:
 - 1. Classrooms (TYPICAL)
 - 2. Classrooms (HYFLEX)
 - 3. Conference Rooms

1.2 SUBMITTALS

- A. Submit shop drawings as specified.
- B. Submit product data on all equipment and cables.
- C. Submit a detailed scale drawing of the entire wiring system.
 - 1. Exact routing, quantity, and size of conduit.
 - 2. Exact routing, quantity, size, and type of cables.
 - 3. Exact location of equipment rack.
 - 4. Exact location of all wireless or audio input points.

1.3 OPERATING AND MAINTENANCE MANUALS

- A. Provide Operating and Maintenance Manuals as specified in Div 26 and Division One.
- B. Include:
 - 1. An "As Built" block diagram of the system showing how the components are connected and where each is located.
 - 2. Wiring diagram for equipment including point-to-point circuit diagrams.
 - 3. Color code of conductors.

PART 2 – MATERIALS

1) CONFERENCE ROOMS (TYPICAL)

- A. VIDEO SOUNDBAR LOGITECH RALLY BAR

2) CLASSROOMS (TYPICAL)

- A. CLASSROOM SYSTEM: EXTRON PLS 201D

3) CLASSROOM (HYFLRX) (TYPICAL)

- A. CAMERAS: Q-SYS NC-12X80
- B. WALL CONTROLLER: Q-SYS TSC-50-G3
- C. HDMI ENCODER/DECODER: Q-SYS NV-32
- D. HDMI ENCODER: Q-SYS NV-21
- E. CONTROL PROCESSOR: Q-SYS CORE NANO
- F. CEILING MICROPHONE: SHURE MXA920W-S
- G. SWITCH: FOR AV NETWORK NETGEAR
- H. CEILING SPEAKER: JBL LCT 81C/T (SEE QTY IN DWGS)
- I. AMP: Q-SYS SPA2-60

PART 3 – EXECUTION

3.01 WIRING AND INSTALLATION TECHNIQUES

- a. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.
- ~~b.~~ Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on a standard duplex outlet. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground as per NEC with third wire (green) to panel ground lug at breaker supply panel.
- c. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment, shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least three.
- d. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.
- e. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.
- f. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.

- g. All wiring shall be labeled as to destination using vinyl wire labeling tags. Use I wire labeling printer. Label input, output and wireless wiring. Label electrical power beaker at electrical panel. Label location of room and power panel/breaker at equipment rack.
- h. Label all mixer inputs with their respective location. Example: mixer input 1 - Mic 1 etc. Name to reflect name on engraved wall plate.
- i. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.
- j. Install equipment cabinet in a controlled temp, dry and accessible area. Provide space to open cabinet completely. Equipment not to be in general gym area where it can be damaged.
- k. Mount wireless antenna as close to equipment rack as possible. Mount/locate so that it will not be a direct target for gym balls etc.

3.2 INSPECTIONS

- A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.
- B. Adjust speaker wattage taps to provide clear, uniform sound coverage throughout gymnasium or cafeteria through entire volume range of amplifier, provide limiter circuit and controls on amplifier to prevent over-driving speaker system.
- C. Contractor shall use white noise generator and spectrum audio analyzer to set overall frequency response and equalization Limiter(s) shall be set to prevent damage to amplifier and speakers. Amplifier to be set to prevent overdriving from pre-amp. Chamber county maintenance personnel to be on site during process.
- D. Demonstrate the performance of the system and give instructions of proper operation and maintenance to the Owner. Provide 2 hrs. Of training and basic system operating instructions - instructions laminated- and affixed to the inside of the front door with appropriate mounting hardware.

3.2 CABLING

- A. General: provide the following cable types for the following functions:
 - 1. Category 6 cable for media devices.
 - 2. One pair #14 AWG twisted to sound reinforcement speakers.
 - 3. RG-58U for wireless mic antenna

END OF SECTION

SECTION 27 60 00 - PHYSICAL SECURITY GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

- A.** Refer to Section 27 00 00 for additional project scope information.
- B.** This section describes the general product and execution requirements related to furnishing and installing Physical Security Systems. Physical Security Systems includes Video Surveillance and Electronic Access Control.
- C.** Contractor shall be responsible for providing complete and functional systems as described in this specification and project drawings.
- D.** Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.
- E.** Contractor coordinate with Electrical Contractor for provision of high voltage power and conduits/raceway, where necessary.
- F.** Contractor shall be responsible for any and all related programming and end-user training unless noted otherwise.

1.02 RELATED WORK

- A.** Section 27 00 00 – Basic Materials and Methods
- B.** Section 27 10 00 – Structured Cabling System
- C.** Section 28 13 00 – Access Control System
- D.** Section 28 23 00 – Video Surveillance System

1.03 REFERENCE

- A.** In addition to any requirements below, Contractor shall abide by requirements delineated in 27 00 00 including but not limited to:
 - 1.** General: Definitions, reference standards and codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.
 - 2.** Products: Substitutions, product specifications, miscellaneous material, cable, connectors, power devices, and interface panels.
 - 3.** Execution: Coordination, testing, training, warranty, and cable management.

1.04 QUALIFICATIONS

- A.** Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.

- B. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).
 - 1. Access Control System programmer shall have completed the Vanderbilt Technical Training Package (VTTP) for the configuration of the Vanderbilt access control system.
 - 2. Video Surveillance System contractor shall have received manufacturer-provided or approved training in the configuration of the Video Insight video management system.
- C. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

1.05 PRE-CONSTRUCTION SUBMITTALS

- A. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the Physical Security Systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:
 - 1. Description of site (field) control equipment (Controllers/Field Panels) and their configuration
 - 2. Operating System(s) Software, where software is provided or upgraded
 - 3. Application Software, with Optional and Custom Software Modules supplied in this project
 - 4. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information, for inter-system communication.
 - 5. Network reliability requirements.
 - 6. Number and location of LAN ports
 - 7. required Number of IP addresses required.
 - 8. Other specific network requirements, preferences, and constraints
 - 9. Backup/archive system size and configuration
 - 10. Access Control Power Calculations
 - 11. Start-up operations
 - 12. Battery backup requirements

1.06 CLOSEOUT SUBMITTALS

- A. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures for each room/system type. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.
 - 1. Upon Owner approval, Contractor shall provide two (2) laminated copies and one (1) digital copy for each room/system type.
- B. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components

with serial numbers and with a unit price greater than \$99. Organize list by room/system type.

PART 2 PRODUCTS

2.01 REFER TO INDIVIDUAL SECTIONS.

PART 3 EXECUTION

3.01 NETWORK TIME PROTOCOL (NTP) SYNCHRONIZATION

- A.** All security systems as well as additional integrated systems such as intercom/PA, SQL/database servers and data logging servers shall synchronize to a common NTP server.
- B.** All systems including servers and workstations shall be within 50ms of each other or less depending on specific system requirements such as failover. The synchronization frequency shall be no less than every 3 hours.
- C.** The Contractor shall coordinate with the Owner for a NTP server connection. The Contractor shall verify the accuracy of the Owners NTP server before utilizing it.
- D.** When a reliable NTP server is not available from the Owner the Contractor shall not utilize the built in Microsoft Windows NTP servers or registry tweaks shall not be utilized. The Contractor shall use software such as NetTime (www.timesynctool.com) installed on the appropriate server.
- E.** Workstations on the private security network shall have an NTP client such as NetTime operating as a Windows service to sync the workstations clock to the same NTP server as the rest of the security systems.
- F.** When an external internet connection is not available the Contractor shall provide a GPS based NTP server such as the Veracity Timenet or equal.

3.02 TRAINING

- A.** On-Site Training
 - 1.** General: Present, review and describe equipment and materials to the Owner and Owner's operating personnel and fully demonstrate the operation and maintenance of the systems, equipment and devices specified herein.
 - 2.** Include with new systems, Contractor to arrange and provide for video recording of each onsite training session.
 - a.** Provide professional video and audio recording of each software screen option with Owner approval of content.
 - b.** Provide end user video recording for Department of Safety & Security approved processes.
 - c.** Provide Security Systems Specialists approved recording of maintenance and troubleshooting process.
 - 3.** Training shall comprise two separate levels of training;
 - a.** User Group upon substantial completion of the

project.

- i. User group training shall include a site/building walk through indicating locations of equipment and their usage.
 - ii. User group training shall include the operation of workstation capability of system monitoring, command override and report generation.
- b. Maintenance Group upon completion of the project prior to close out.
 - i. Maintenance group training shall include a site/building walk through indicating locations of equipment and their usage at up to six representative sites.
 - ii. Review of a-build documentation at each controller location.
 - iii. Troubleshooting techniques in hardware and software.
- 4. The training shall cover the overall system, each individual system, each subsystem, and each component. The training shall also cover procedures for database management, normal operations, and failure modes with response procedures for each failure. Each procedural item shall be applied to each equipment level.
- B. Duration: Refer to the individual sections for the minimum time requirements.

3.03 WARRANTY

- A. Furnish and guarantee maintenance, repair and inspection service for the system using factory trained authorized representatives of the manufacturer of the equipment for a period of one year after final acceptance of the installation.
- B. Third Party Device warranties are transferred from the manufacturer to the Contractor, which may then transfer third party warranties to the Owner. Specific third party warranty details, terms and conditions, remedies and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product.
These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer.
- C. Purpose
 - 1. The Contractor shall repair any system malfunction or installation deficiency discovered by the Owner or their representatives during the burn in and warranty period.
 - 2. The Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner or their representatives during the warranty period.

3.04 EXAMINATION OF SITE AND DOCUMENTS

- A. Bidder shall examine all documents, shall visit the site(s) prior to submitting proposal, record their own investigations, and shall inform themselves of all conditions under which the Work is to be performed at the site(s) of the Work, including the structure of the ground, the obstacles that may be encountered, and all of the conditions of the documents, including superintendence of the Work, requirements of temporary environmental controls, the time of completion, list of Subcontractors, and all other relevant matters that may affect the Work or the proposal process.

- B. Verify cable lengths comply with published standards.
- C. Notify Owner/Consultant of installation that would exceed maximum lengths prior to installation of cable.
- D. Contactor shall consult with Owner/Consultant regarding alternative routing or location of
- E. cable. Do not proceed until unsatisfactory conditions have been corrected.
- F. Failure to make the examination shall not result in any Change Order requests.
- G. The Bidder shall base the proposal on the site(s) examination, materials complying with the plans and specifications and shall list all materials where the proposal form requires.
- H. The commencement of work by the Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to the Owner/Consultant prior to commencement.
- I. If the Contractor observes, during preliminary examinations or subsequent work, existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, the Contractor shall report these to the Owner/Consultant in a timely manner.

3.05 INSTALLATION REQUIREMENTS

- A. Contractor shall furnish and install all cables, connectors, and equipment as shown on Drawings and as specified herein.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.
- C. Beginning installation means Contractor accepts existing conditions.
- D. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment shall include, but not be limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices that may move or wear in a manner to pose a hazard to the cable shall not be used.
- E. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away," or other approved method.
- F. The Contractor shall be responsible for identifying and reporting to the General Contractor any existing damage to walls, flooring, tiles, and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway, or other hardware shall be repaired by the Contractor.
- G. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor- damaged ceiling tiles, floor, and carpet shall to be replaced to match color, size, style, and texture.
- H. Where unacceptable conditions are found, the Contractor shall bring this to the attention of

the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

- I. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as to feed cable and operate pulling machinery.
- J. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.
- K. All wiring shall be run "free-air," in conduit, in a secured plastic raceway or in modular furniture as designated on the Drawings. All cable shall be free of tension at both ends. PLENUM rated cable shall be used in areas used for air handling.
- L. Avoid abrasion and other damage to cables during installation.
- M. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
- N. The cable system will be tested and documented upon completion of the installation as defined in the section below.
- O. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway. Should it be found by the Consultant that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and Drawings with the respect or regard to the quality, amount of value of materials, appliances, or labor used in the work, it shall be rejected, removed, and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be corrected at the Contractor's expense.
- P. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by manufacturers or as indicated in their published literature, unless specifically noted herein to the contrary.

3.06 COOPERATION

- A. The Contractor shall cooperate with Consultant's and Owner's personnel in locating work in a proper manner.
- B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

3.07 COMMISSIONING SUBMITTALS

- A. Provide the following to the Owner no later than 30 days prior to system commissioning/programming.
 - 1. Commissioning Test Plan and Check-Off List: Specified elsewhere in this
 - 2.

document. Web-based Training: Access to web-based training modules.

3.08 COMMISSIONING

- A.** Provide programming and commissioning for each system as described in individual sections below.
- B.** This Contractor shall develop and submit a plan for coordination of settings and programming issues with the Consultant and Owner no later than 30 days prior to performing programming and commissioning.
- C.** The security Contractor is required to place entire system into full and proper operation as designed and specified.
- D.** Verify that all hardware components are properly installed, connected, communicating, and operating correctly.
- E.** Verify that all system software is installed, configured, and complies with specified functional requirements.
- F.** Perform final acceptance testing in the presence of Owner's representative, executing a point-by-point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.
 - 1.** Submit documented test plan to Owner at least 14 days in advance of acceptance test, inspection, and check-off.
 - 2.** Conduct final acceptance tests in presence of Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.
 - 3.** Acceptance by Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.
 - 4.** The system shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

3.09 OPERATION AND MAINTENANCE MANUALS

- A.** Part One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after Final Acceptance of the Installation:
 - 1.** Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring and relationships as they were constructed. Include nomenclature showing as-built wire designations and colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD 2018 files, in ".dwg" format and Adobe Portable Document Format ".pdf" on USB flash drives.
 - 2.** Manuals: Submit one (1) copy of each of the following materials in an electronic PDF, with labeled dividers:
 - a.** A final Bill of Material for each system

- ### 3.10 CLOSEOUT PROCEDURES

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meet the specifications in the Bid package, and/or unacceptable to the Architect/Consultant shall be documented by the Architect/Consultant and provided to Contractor to rectify.

- E. Re-Inspection: If a re-inspection is necessary, the costs of the Architect/Consultant's additional travel, hours, and expenses may be deducted by the Owner from the contract amount due Contractor.
- F. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner and Architect/Consultant.
- G. The system has successfully completed a 30-day performance period.
- H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by the Owner and Architect/Consultant, including punch list(s) and/or re-inspection(s).
- I. Response Time: Response time for service calls.
 - 1. Emergency service calls where system is not responding to staff directed commands through the computer systems shall be within 2 hours to the project site.
 - 2. Emergency service calls where controllers are not reporting shall be within 2 hours to the project site.
 - 3. Normal service calls for device malfunctions shall be within 24 hours during normal working hours to the site.
- J. Repair Time: Contractor shall stock parts in sufficient quantities such that repair or replacement shall be guaranteed within 12-hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality, and provided permanent replacement is achieved within 72 hours. Contractor may contact Owner representative for use of Owner supplied spare parts where delay of system repair will have negative impact on system performance.
- K. Commencement: The warranty begins at the time of issuance of the statement of "Final Acceptance of the Installation" by the Owner.
- L. Transferability: The warranty shall be transferable to any person or persons at the discretion of the Owner.
- M. Transmittal: A copy of this Warranty shall be delivered to, and signed for by the Owner's representative whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.
- N. Registration: Register Warranty papers for all equipment and software in the name of the Owner. Furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.
- O. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.
- P. Resolution of Conflicts
 - 1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory, stating specific areas of dissatisfaction in writing.

2. If the Contractor or his approved Subcontractor does not resolve such stated areas of dissatisfaction within thirty (30) days, the Owner may appoint any alternative service agency or person to fulfill the terms of the Warranty; the cost of which shall be borne by the Contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

END OF SECTION

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.
- C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.
- D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.
- G. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.

1.3 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

- A. Provide utility services conduit as outlined on drawings as required.
- B. All required conduit for accessibility to attic space.
- C. Furnishing and installation of all required standard back boxes and conduit.
- D. Installation of special back boxes supplied by Division 28 contractor(s).
- E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
- F. Provide equipment-mounting boards as outlined on drawings.
- G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.

- H. Provide 120-volt power and hook-up to equipment provided in Division 28.
- I. Coordination of requirements of Division 28 with the Builder.

1.4 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.5 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 05 34 - Provisions For Communication, Security & Safety Systems.

1.6 CODES, STANDARDS, AND THEIR ABBREVIATIONS

- A. General:
 - 1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
 - 2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
 - a. OSHA Safety and Health Regulations for Construction.
 - b. NFPA No. 70 National Electrical Code.
 - c. NESC National Electrical Safety Code, ANSI Standard C2.
 - d. NEIS National Electrical Installation Standards.
 - e. Local Codes and Ordinances.
- B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.
- C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, the City of Little Elm, Texas, and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.7 LIST OF ASSOCIATIONS AND STANDARDS:

- ADA: Americans with Disabilities Act.
- ANSI: American National Standards Institute, 1430 Broadway; New York, NY 10018.
- ASTM: American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
- BICSI: (RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637

CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
ICEA:	Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC:	National Electrical Code; NFPA No. 70.
NECA:	National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
NEMA:	National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
NESC:	National Electrical Safety Code, ANSI Standard C2.
NFPA:	National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
OSHA:	Occupational Safety and Health Administration, US Department of Labor; Washington, DC 20402.
TAS:	Texas Accessibility Standards (TAS) Article 9102.
UL:	Underwriters Laboratories, Inc., 333 Pfingsten Road; Northbrook, IL 60062.

- A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
- B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.8 DEFINITIONS

- A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.
- B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.
- C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.

- D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.
- E. PDF file or .pdf: The filename extension associated with "Portable Document Format" files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.
- F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.9 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

- A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.10 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.11 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.12 SUBMITTALS

- A. Submittal procedures shall be per Division 1 - General Requirements.
- B. Provide a complete submittal for each section as specified.
- C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- E. Each Product data submittal shall include:
 - 1. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. When the contract requires extended product warranties, submit a sample of warranty language.
 - 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
- F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.13 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.

- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.
- C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:
 - 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 - 2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
 - 3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
 - 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 - 5. Any and all other data and/or plans required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 - 7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. Builder and all Contractors.
 - b. Major Equipment Suppliers
 - c. Submit communication systems warranties.

1.14 TRAINING

- A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.
- B. See other sections for time requirements.

1.15 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.
- D. If clarification is needed, consult the Architect/Engineer.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.
- F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.16 PRODUCT SUBSTITUTIONS:

- A. Descriptions and details, acceptable manufacturers' names listed, and specific

manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.

- B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.
- F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
 - f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by

the Contractor originating the changes.

1.17 FUTURE USE CABLING

- A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.
- B. Locations and Existing Conditions:
 - 1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
 - 2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.18 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.19 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

1.20 PROHIBITED MATERIALS

- A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the

sole risk of the Contractor and his personnel.

1.21 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

1.22 MANUFACTURERS' INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.23 INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. The Electronic Safety Contractor shall coordinate installation of the systems with the

Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.

- C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.
- D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.
- E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.
- H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.24 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

- A. Not Applicable

PART 3 – EXECUTION

- A. Not Applicable

END OF SECTION 28 05 00

SECTION 28 05 44 – EMERGENCY RESPONDER RADIO ANTENNA SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. Design, furnish, install, and test a complete and operating in-building Emergency Responder Radio Antenna System/Distributed Antenna System ['system' or 'DAS'] to provide complete coverage for the public safety agencies as required by the local fire department, other agencies and the authority having jurisdiction [AHJ]. The system will support only Emergency Responder and Public Safety Land Mobile Radios ['LMR']. The system shall not support District Radio, Cellular, and/or Wi-Fi Signals.

1.3 WORK INCLUDES

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 apply to this Section.
- B. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete Emergency Responder Radio Antenna System. The purpose is to extend and amplify the Emergency Responder and Public Safety Land Mobile Radio signals to a strength of 95% in all areas of the facility including elevators, stairwells, and all floors.
- C. It shall be the responsibility of the Emergency Responder Radio Antenna System contractor to obtain all required permits, approvals and certifications from the authorities having jurisdiction.
- D. All fees associated with the licensing shall be paid by the Contractor.
- E. Testing of the system shall conform to the testing requirements as described in the International Fire Code [IFC] Section 510.5.3.
- F. All testing must be done on frequencies authorized by the FCC and in use by local agencies as directed by the Authority Having Jurisdiction [AHJ].
- G. Final acceptance and approval shall be required from the local AHJ.
- H. It shall be the responsibility of the Electrical Contractor to provide and install all conduit systems, standard electrical boxes, and operating power for the building access systems as outlined on the project drawings. This Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit. The BDA head end shall be hardwired to electrical power and on emergency power where possible.
- I. The Electrical Contractor shall provide 120-volt power as required through separate dedicated branch circuits, maximum 20 amperes each. Each such circuit shall be labeled at the power distribution panel as EMERGENCY RESPONDER RADIO SYSTEM. The location of all circuit breakers serving the Emergency Responder Radio Coverage System

shall be posted in the control unit cabinets. Each cabinet and all surge protection devices shall be grounded securely to the building grounding system.

- J. Provide all testing, documentation, training, and warranty service contract as outlined in these specifications.
- K. Section shall include:
 - 1. Bi-Directional Amplifiers [BDA's]
 - 2. Distributed Antenna System
 - 3. Coaxial Cables
 - 4. Splitters and Directional Couplers
 - 5. Battery Back-Up System
 - 6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna System.
- L. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

1.4 SYSTEM PRICING, PHASING AND AWARD

- A. Proposed Contractor shall provide a proposal based on separate pricing for each of the following steps:
 - 1. Outdoor Testing of the Facility – This price shall include verifying the outdoor signal strength at the facility's location.
 - 2. Full Testing, in accordance with IFC Section 510 Grid Testing – This price shall include verification of signal strength throughout the entire facility.
 - 3. Emergency Responder Radio Antenna System Materials and Installation Pricing – This price shall include a full system design and installation, including costs for design, components, materials, labor, and testing. This price shall be a "Worst-Case Scenario" situation, as though the entire facility must require coverage.
- B. The project must be budgeted as a complete set of processes, thus the reason for having all pricing, in a "Worst-Case Scenario" prior to performing any work. This pricing will provide a budget before the work begins.
- C. The award of this work will be made in phases, in accordance with the three (3) afore mentioned steps.
 - 1. Phase I award authorizes step #1. Once step one is completed, results are to be provided to the General Contractor, Architect, and Engineer for review. Following this review, step two may be delayed, pending adjustment to the donor signal. If donor signal strength at the facility does not meet IFC Section 510 requirements, the AHJ must be consulted, prior to moving to step two. If the donor signal strength is adequate to meet IFC Section 510 requirements, authorization for step two will be given.
 - 2. The Phase II award authorizes step #2. Testing of the facility to determine signal strength status and to provide a base for a full system design. After testing, a final revised proposal for a full system design, installation and final testing shall be issued to the General Contractor for review. No further work is authorized until award of Phase III is granted.
 - 3. Phase III award authorizes step #3. Design, installation, and final testing of the Emergency Responder Radio Antenna System. Provide design and final

acceptance testing documents per Section 1.8.

1.5 MANUFACTURERS

- A. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include, but are not limited to:
 - 1. CommScope
 - 2. Farenhyt
 - 3. Axell Wireless
 - 4. Tessco
 - 5. Times Microwave
 - 6. Gamewell-FCI
 - 7. Notifier
 - 8. SOLiD Technologies – Alliance Corporation
 - 9. Simplex
 - 10. Honeywell
 - 11. Other manufacturers upon approval.

1.6 RELATED SECTIONS

- A. Section 26 05 34 - Provisions for Communication, Security & Safety Systems.
- B. Section 28 05 00 - General Electronic Safety and Security System Requirements.
- C. Section 28 31 00 – Fire Detection and Alarm System

1.7 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
 - 1. NFPA 1 – The National Fire Code (including Annex O from 2009)
 - 2. NFPA 70 – The National Electrical Code
 - 3. NFPA 72 – National Fire Alarm Code
 - 4. NFPA 1221 – Standard for the Installation, Maintenance and Use of Emergency Services Communication Systems
 - 5. UL 2524 - 1st Edition In-building 2-Way Emergency Radio Communication Enhancement Systems
 - 6. FCC 47 CFR Private Land Mobile Radio
 - 7. FCC 47 90.219-2007 Services-Use of Signal Boosters
 - 8. ICC 2009 International Fire Code, Code and Commentary
 - 9. ADA “Americans with Disabilities Act”
 - 10. FCC’s OET 65 Standards “Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”
 - 11. FCC Rules Part 22, Part 90, and Part 101

1.8 DEFINITIONS

- A. Attenuation: The reduction in signal power, expressed in decibels, as a result of coupling, heat loss, or transmission distance in a cable or in air.

- B. Bi-Directional Amplifier [BDA]: A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage. Also known as a signal booster.
- C. Coupled Bonding Conductor [CBC]: a bonding conductor placed on the outside of any technology cable. Used to suppress transient noise.
- D. Delivered Audio Quality Definitions [DAQ]: The universal standard often cited in system design, specifications, and testing reports for ERRC and DAS.
 - 1. DAQ 1: Unusable, speech present but not intelligible.
 - 2. DAQ 2: Understandable with considerable effort. Frequent repetition required due to noise and/or distortion.
 - 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise and/or distortion.
 - 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise and/or distortion
 - 5. DAQ 4: Speech easily understood. Occasional noise and/or distortion.
 - 6. DAQ 4.5: Speech easily understood. Infrequent noise and/or distortion.
 - 7. Speech easily understood.
- E. Distributed Antenna System [DAS]: A network of service antennas connected at intervals along shielded coaxial transmission lines and all connected to head-end electronics amplifying the signals to be distributed. Often refers to a system that includes both the passive distribution system and the active amplifying electronics.
- F. Directional Coupler: A component which directs a small portion of downstream RF energy to a port which can be connected to an antenna or another branch of distribution cabling, and also serves as a combiner of upstream energy between the tap port and through the connection port.
- G. Donor Antenna: The antenna, usually mounted on the outside of a structure where a DAS is installed, which picks up signals over-the-air from a donor source.
- H. Donor Source: The repeater, transceiver, cell site, or other radio site that produces signals which a DAS will relay and distribute.
- I. Emergency Responder Radio Antenna System [ERRAS]: A two-way radio communication system installed to assure the effective operation and coverage of radio communications systems for fire, emergency medical services, and/or law enforcement agencies within a building or structure. The system is not designed for use with District LMR, Cellular Services, or Wi-Fi Services.
- J. Federal Communications Commission [FCC]: federal agency responsible for implementing and enforcing America's communications laws and regulations.
- K. OET 65 Standards: The FCC's Bulletin that provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- L. Public Safety and/or First Responder: agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to, law enforcement, fire departments, and emergency medical services.
- M. Reflected Power: Power which is reflected back along a transmission line as a result of discontinuities in line impedance caused at connectors or close proximity of metallic objects.

- N. Radio Frequency [RF]: Energy from electromagnetic waves, or alternating currents that produce electromagnetic waves, in the spectrum of radio frequencies (30 kHz to 300GHz)
- O. Signal Booster: See BDA
- P. Splitter: A passive component that has a single input port and two or more output ports, effectively splitting the signal equally amongst the output ports. It also serves to combine upstream signals from the "output" ports into composite signals at the "input" port.

1.9 SUBMITTALS

- A. Submittal procedures: See Section 28 05 00.
- B. Submit a complete submittal package within 30 calendar days, for approval, after award of this work. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- C. Submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- D. Quality Assurance Submittal:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology and products comply with specified requirements and FCC Regulations.
 - 3. The system described in the submittals shall be certified by an FCC Licensed Designer and installation shall be supervised by an FCC Licensed Project or Installation Manager.
- E. Product Data Submittal including special boxes, cable and other material as requested by the Architect/Engineer including:
 - 1. A cover sheet with the name and location of the project, the name, address and telephone number of the Contractor and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. Copies of FCC Licenses for both the Designer and Project or Installation Manager.
 - 3. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 4. A product data index and complete equipment list including for each product submitted for approval the manufacturers name and part number including options and selections.
 - 5. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted for approval.
 - 6. Submit design data when the scope of work requires, including passband curves for both uplink and downlink for all bands, calculations, schematics, risers, sequences, or other data.
 - 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
 - 8. Any rejected submittals must be corrected and resubmitted to the AHJ and

Architect/Engineers within 10 days of receipt of the rejected material.

- F. Submit shop drawings locating all components of the system, indicating circuit routing, cable type, and gauge. Shop or coordination drawings shall include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, risers, floor plans and accurate to scale, (minimum of 1/8" = 1'-0"), equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. Testing
 - 1. Submit all field test records of the radio systems. These shall include, but not be limited to:
 - a. Preconstruction Tests – Tests performed with the AHJ prior to construction of the new facility to verify that the municipality has signal coverage in that area.
 - b. Mid-Construction Tests – Tests performed with the AHJ during construction once walls have been constructed and the exterior roof is installed.
 - c. Final Testing – Tests performed in conforming with IFC Section 510.5.3 and Section 510.6. This testing is to be signed off by the AHJ. Engineers shall also be present for the final testing process.
 - 2. All testing records shall be submitted with O&M information and close out documents.
 - a. Provide one (1) digital copy of all close out documents
 - b. Provide three (3) copies of closeout documents bound in a 3-Ring binder with dividers and table of contents.

1.10 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- B. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the emergency responder radio coverage system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing emergency responder radio coverage systems for a period of at least 5 years.
- C. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/ Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- D. The Contractor shall employ factory trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- E. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full-time factory employed service staff for product support and service.
- F. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners

representatives in the proper operation of the system, and to provide service throughout the warranty period.

- G. All testing shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License and be a full-time employee of contractor.
- H. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the school district to allow school administration officials to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
- I. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- J. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- K. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- L. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- M. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- N. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The system shall conform to the requirements as identified in IFC Section 510.4 and Section 510.5. Testing records are required to confirm performance of the system.
- B. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna systems, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- C. Power Supplies: At least two (2) independent and reliable power supplies shall be provided: one primary and one secondary. The primary power source shall be supplied from a dedicated 20-ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The

secondary power source shall be a dedicated battery back-up, capable of operating the in-building system for at least 24 hours at 100% operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 type enclosure. Monitoring the integrity of the power supplies shall be in accordance with 4.4.7.3 of NFPA 72.

D. Survivability

1. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
2. Cabinet: The signal booster and all associated equipment shall be housed in a single NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting from inside of the cabinet to outside atmosphere. Equipment installed on the roof of structures shall be rated for the expected extreme temperature and weather associated with rooftop installation.
3. Rooftop Installations shall require a Pitch Pocket for proper weather-tight roof penetrations.
4. Passive equipment: Passbands shall be VHF, UHF, and 700-900 MHz, IP rating of 2GHz.

2.2 SYSTEM COMPONENTS

A. Signal Strength

1. Downlink: A minimum signal strength of -95dBm shall be provided throughout the coverage area.
2. Uplink: A minimum signal strength of -95 dBm shall be received at the local municipality from the coverage area.
3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

B. Permissible Systems

1. Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional VHF, UHF, and 700-900 MHz amplifier(s) as needed.
2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.

C. Supported Frequencies: The system shall support VHF, UHF, and 700-900 MHz as required for local public safety and first responder bands as utilized by the local municipality.

D. Reject Filters: Notch filter sections shall be incorporated as necessary.

E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes with the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.

G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations and/or other abnormal conditions that may

occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications.

- H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
- I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.3 SYSTEM MONITORING

- A. The distributed antenna system shall include connections to the fire alarm system to monitor the operational integrity of the signal booster, power supplies and annunciate malfunctions on the fire alarm system. Coordinate and provide this integration, as part of this system, with the fire alarm system contractor that is authorized to service the facility's fire alarm system. The integration of the DAS with the fire alarm system shall comply with Chapter 10 of NFPA 72.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local municipality indicating that they shall be notified of any failures that extend past the 2- hour time limit.
- C. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - 1. Normal AC power
 - 2. Signal booster trouble
 - 3. Antenna Failure
 - 4. Loss of normal AC power
 - 5. Failure of battery charger
 - 6. Low battery capacity

2.4 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring, and equipment installation shall be in accordance with good engineering practices. Wiring shall meet all state and local electrical code requirements.
- B. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, deburred, cleaned, and secure prior to installation of cable.
- D. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- E. In all exposed areas such as mechanical rooms, parking garages, stairwells, etc., cable shall be fully enclosed in conduit.
- F. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.

- G. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- H. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- I. Cable must not be fastened to electrical conduits, mechanical ductwork or piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. System cables shall not be run loose on ceiling grid or ceiling tiles.
- J. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- M. Do not route any communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. System cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- O. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractors shall coordinate with an FCC licensed engineering firm regularly employed in the business of designing and implementing Emergency Responder Radio Antenna Systems for emergency responders.
- B. Electrical Work:
 - a. Proposed Contractor is required to provide for and coordinate with Electrical Contractor for any, and all required electrical work, including but not limited to, circuiting, conduits, back boxes, and more. These expenses will not be included in the electrical contractor primary bid.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
- B. Store and protect equipment in a conditioned space until installation.

3.3 SYSTEMS INSTALLATION

- A. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
- B. All equipment shall be connected according to the OEM's specifications to insure correct

installation and system performance.

- C. Coordinate all roof penetrations with General Contractor and/or Roofing Contractor.

3.4 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.5 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner. All testing shall meet the testing standards set forth in IFC Section 510.
- B. This contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed Emergency Responder Radio Antenna System including all components and controls to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Verify proper operation and processing of signals.
 - 4. Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 - 5. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.
- D. A final System Acceptance Test shall be performed in the presence of a designated Owner representative and the AHJ. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will be re-tested via a punch list to ensure that they comply with the system requirements.
- E. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment, cabling or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.
- F. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.6 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring

black binder of sufficient size.

- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all calculation sheets used to configure the system.
- D. Formal on-site training sessions shall be conducted by the Emergency Responder Radio Antenna System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION 28 05 00

SECTION 28 13 00 – ACCESS CONTROL

PART 1 - GENERAL

Unless noted otherwise, "Contractor" or "This Contractor" refers to the Security Contractor.

1.1 SUMMARY

- A The Contractor shall provide and install a new access control system at the facility, providing all components and programming necessary for a turnkey expansion. Refer to the technology drawing sheets for exact locations and other requirements.

1.2 SCOPE OF WORK

- A Provisions of Section 27 10 00, previous sections, and Construction Documents are included as a part of this section as though bound herein.
- B The contractor shall include in his bid the cost of all other trades required to install a complete access control system.
- C It is the intent of the contract drawings and specifications that the contractor provides an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this or other sections, it shall be the responsibility of this contractor to provide all material and equipment which is usually furnished with such system in order to complete the installation, whether mentioned herein or not.
- D These specifications are accompanied by drawings indicating some devices and details of the installation. The drawings and specifications are complementary to each other, what is required by one shall be binding as if required by both.
- E If the contractor deems any departure from the drawings necessary, details of such departure and reasons therefore shall be submitted to the Owner's representative for approval.
- F Should the drawings disagree in themselves or with the specifications, the better quality of work and materials shall be estimated. Notify the Owner's representative of disagreement prior to the start of any installation.

1.3 RELATED WORK

- A Section 27 10 00 – STRUCTURED CABLING SYSTEM
- B Section 28 21 00 – VIDEO SURVEILLANCE SYSTEM
- C Section 28 31 00 – FIRE ALARM SYSTEM

1.4 SYSTEM DESCRIPTION

- A The access control system shall consist of all detection devices, control panels, security terminals (keypads), power supplies, notification appliances, signaling devices, zone expansion modules, equipment cabinets, water detection devices, proximity card readers and any auxiliary components installed, wired, or otherwise connected in accordance with the drawings, this specification and the manufacturer's specifications to function as intended. It is the intent of these specifications to provide an installation at each site which is complete in every respect. In the event that any additional details or special construction is required for the work intended, it shall be the responsibility of the contractor, whether mentioned herein or not. The drawings indicate approximate locations of some devices.

Verify final location of devices with District prior to rough-in. The contractor shall be responsible for determining the final layout and exact placement of the system components to ensure coverage which fully satisfies the intent of these specifications and is at least as complete as that reflected on the drawings.

1.5 QUALITY ASSURANCE

- A Utilizing standard products and pieces, components of the system shall be listed and labeled as products of a single manufacturer under the appropriate category by Underwriter's Laboratories, Inc.
- B The system shall be engineered by a factory trained, authorized representative and licensed installer.
- C Local availability of parts and service is a requirement for bidding. Parts must be available locally, within a 75-mile radius of the job site.

1.6 SUBMITTALS

- A In addition to complying with the submittal requirements described in sections 27 10 00. Contractor shall submit to and receive approval from the Owner's representative, three copies of the following information:
 - 1. **Line by line specification review stating compliance or deviation.**
 - 2. Manufacturer's technical product data on all components and miscellaneous materials. Include module space requirements on the motherboard and/or in the cabinet, and data substantiating that the equipment will comply with the requirements.
 - 3. A written system description detailing all modules and/or components of the system, with particular emphasis on conformity to this specification.
 - 4. Written system sequence of operation detailing all operational aspects of the system.
 - 5. CAD generated riser diagram, point-to-point wiring diagrams and floor plans, at the same scale as the contract documents, showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and proposed addressing with nomenclature read-out to be used.
 - 6. Calculations for battery sizing requirements.
 - 7. Submit to and receive approval from the Special Systems section of the Maintenance department, three copies of the following information:
 - a. CAD generated riser, point-to-point wiring diagrams and floor plans, at the same scale as the contract documents, showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and proposed addressing with nomenclature read-out to be used.

1.7 CONTRACTOR QUALIFICATIONS

- A The contractor shall be an authorized representative of the manufacturer.
- B The contractor shall be licensed to install, modify and service the system.
- C Field technicians must have a minimum of 4 years of experience.
- D Any other personnel will be directly supervised on a one-on-one basis.
- E Maintain a complete service organization within a 75-mile radius of Project site.

1.8 OPERATIONS AND MAINTENANCE DATA (CLOSE OUT DOCUMENTS)

- A Furnish one data-programming disk with all system software required for a re-start

- after a traumatic failure. Software must be of appropriate and compatible update version for the firmware installed.
- B. Furnish two electronic and three paper copies of "As-Built" drawings at the same scale as the contract documents with riser, point-to-point wiring diagrams, partitioning, wire routing, color coding of conductors, and any unspecified information that would be beneficial to the Owner for future planning or to technicians for system troubleshooting, and floor plans showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and addressing with nomenclature read-out used.
- C. Terminations, junction points and splices shall be clearly recorded on the as-built drawings.
- D. The locations of the "end of line" devices shall be clearly marked on the as-built drawings.
- E. Detector alarm initiating loop resistance readings shall be recorded on the as-built plans.
- F. Furnish three copies, for each component:
1. Equipment operations manuals.
 2. Equipment maintenance and testing manuals.
 3. Equipment data and parts lists.
- G. Furnish three signed letters of guarantee, which specifies the substantial completion date and the guarantee period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Control panels and power supplies shall be housed within a locking metal cabinet, and keys shall be provided to the Owner.
- B. Control panels shall be capable of communicating either in pulse dial or DTMF mode.
- C. Batteries shall be sized for 4 hours on standby and 15 minutes in alarm.
- D. Control panel(s) shall be earth grounded in strict accordance with the manufacturer's specifications and shall be provided with circuit protection from EMI and RF interference.
- E. Control panels shall be equipped with devices intended to provide protection from the effects of transient voltages caused by lightning, in accordance with manufacturer's specifications.
- F. Zone expansion modules and associated power supplies, relay modules, siren drivers and standby batteries shall be housed within a locking metal enclosure and placed where not susceptible to tampering.
- G. Zone expansion modules shall support a minimum of eight fully programmable zones each and shall be listed as compatible to the control panel.
- H. All proximity card readers shall be fully weatherized with operating temperatures of -31°F to 149°F and an operating humidity of 5-95% non-condensing.

2.2 ACCESS CONTROL EQUIPMENT

- A. Access Control Software (Approved Vendors)

- 1. Genetec**
- B. Access Control File Server
 1. Security Contractor provided. The Security Contractor will provide an option to provide a virtualized access control server onto Owner provided hardware (Software only)
- C. Access Control System Controllers
 1. The latest Mercury LP Intelligent Controllers
 2. The latest Mercury MR serial Input/Output (SIO) sub controllers
 - a. The Access Control system will operate in Open Supervised Device Protocol (OSDP) mode.
- D. Card Reader
 1. HID 40NKS-T2-000000 Signo 40 Wall Mount Reader, 13.56mHz Profile, OSDP/Wiegand, Pigtail, Mobile Ready, Black/Silver, HID Global, Category: HID Global, Access Control, Keypads & Readers, Smart Readers Access Control Cards (Qty:100)
 2. HID 20NKS-T2-000000 Signo 20 Mullion Reader, 13.56mHz Profile, OSDP/Wiegand, Pigtail, Mobile Ready, Black/Silver, HID Global, Category: HID Global, Access Control, Keypads & Readers, Smart Readers
 3. HID Global iCLASS® Seos™ smart card, with contactless iCLASS Seos with flexible memory allocation, Printable. Part number 52260PSGGAAN
 4. The Security Contractor shall provide an initial quantity of 100 clear rigid plastic vertical Badge holder with slot and chain holes, as well as breakaway lanyards with a plastic clasp. The Security Contractor shall closely coordinate with the owner on the design and color of the lanyards.
 5. The Security Contractor will be responsible to provide the initial ID badge production of the ID/access cards. The Security Contractor shall contract with HID directly to produce the initial ID badge production. For bidding purposes, the Security Contractor shall provide pricing for the initial production of 100 ID badges with additional incremental pricing of 20 ID badge production. The Security Contractor shall closely coordinate with the owner to meet this badging requirement.
- F. Door Contacts
 1. **Provide 2 pole, double throw door contacts for connection to intrusion detection and access control independently.**
 2. Concealed/Surface Mounted Door Position
 - Switch 3. GE/Sentrol 1076/1078/2700
 4. Or approved equivalent
- G. Power supply/enclosure
 1. Life Safety Power UNIFIEDPOWER™ Mercury Unified Power model FPO150/250- 2D8P2M8NL4E8M2.
 2. Or approved equal
- H. **Access Control Composite Cable**

1. **Beldon Part Number: 538AFS - Access Control, all system cable shall be plenum rated.**
2. **All new access control cabling shall have a green outer jacket.**
3. **Or approved equal**

2.3 GUARANTEE

- A. The systems shall be guaranteed to be free from all defects in material and workmanship for a period of one year from the date of substantial completion. Equipment or components showing inherent defects of a mechanical or electrical nature shall be replaced promptly at no expense to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Drawings indicate a general placement of components. Specific placement shall be determined by the installer to provide best fit and function.
- B. The contractor shall furnish and install all specified materials and non-specified materials as required to make the system fully operational.
- C. Abandoned ceiling mounted devices are to be equipped with new ceiling tiles.
- D. Surfaces of abandoned devices and equipment are to be restored by covering, patching and painting.
- E. Materials shall be used only for the purposes for which the manufacturer had intended. No used, obsolete, or installer modified equipment shall be installed or connected.
- F. Boxes and cabinets shall be attached to structural components by hangers or fittings designed for the purpose.
- G. System components, devices, detectors, control panels and power supplies shall allow sufficient clearance for testing and maintenance.
- H. "End of Line" resistors are to be located within the enclosure housing of the final device.
- I. Installer shall coordinate the installation of system components and cabling with other trades to assure a complete installation in a craftsman like manner.
- J. Debris, dirt, packaging, wiring scraps or other refuse shall be cleaned and discarded by the contractor at the end of each workday.
- K. Install temperature alerts in all IDF and MDF rooms.
- L. Access control to interface with ADA doors.

3.2 CONTROL PANEL

- A. No programming sequences, codes or passwords shall be entered into the operation software of the system to prevent the Owner from access to all available system operating functions or system microprocessor programming.
- B. Any peripheral devices, software, passwords, programming codes, manuals, adapters, etc., necessary for programming any part of the system shall be provided as a condition of the contract.
- C. Control functions shall be programmed as directed by Special Systems.

- D. The control panel(s) shall be earth grounded in strict accordance with the manufacturer's specifications.
- E. Power supply shall be installed directly below security panel.

3.3 SUPPLY SOURCE (120 VAC) – WORK TO BE PERFORMED BY E.C.

- A. Power connections shall comply with the latest edition of the National Electrical Code and executed by a licensed electrical contractor.
- B. Power connections will not be allowed within the security cabinets.
- C. Provide new circuit breakers, conduit, wiring and receptacle(s) for all equipment installed.
- D. Conduit runs shall be neatly routed and parallel or perpendicular to building lines.
- E. Access control system equipment shall be hard wired.
- F. Wiring is not to feed-thru other equipment.

3.4 PROXIMITY CARD READERS

- A. Verify final locations of all card readers with district prior to rough-in.
- B. Run minimum 18AWG, 6 conductor cable to readers.

3.5 CABLING METHODS

- A. Installation of the wiring for the system is part of the work of this section but is not specifically detailed on drawings. Determine the exact number and size of conductors required for each type of device installed. Size the conductors to prevent any voltage drop which renders the device inoperable. Comply with the minimum size and quantity requirement. Use minimum wire sizes to devices as recommended by manufacturer.
- B. Cable jackets shall not be red in color.
- C. Install new stranded copper wiring using, un-spliced from point to point, plenum rated cables, types CMP only, designed for the intended use.
 - 1. Minimum conductor sizes and quantities:
 - a. 18 AWG
- D. Data bus wiring shall not be placed within 6" of intercom wiring, lighting fixtures or power service wiring and shall not be run next to detector circuit, telephone or siren circuit wiring.
- E. Installation of all cables shall be in accordance with Article 800 of the National Electrical Code and with the cable manufacturer's recommendations.
- F. Cabling shall be supported from the building structure and shall not be laid across electrical conduits, lighting fixtures, piping, mechanical equipment, suspended ceiling grids or the work of other systems. Ceiling grids shall not support cables. No cabling shall be run under ductwork or mechanical equipment.
- G. Cabling, regardless of elevation, shall be enclosed in a raceway unless within a wall or located above an accessible, suspended ceiling.
- H. Cables shall be neatly routed and parallel or perpendicular to building lines.
- I. Cables, raceways and equipment installed behind panels designed to allow access, including suspended ceiling panels, shall be arranged and secured so as to allow the

- removal of panels and access to the equipment.
- J. Conductors within the control panel enclosure shall be neatly and permanently labeled indicating circuit type or zone and number and neatly dressed and secured with nylon wire ties or straps.
 - K. Detector circuit wires shall be neatly grouped or bundled together.
 - L. Cable penetrations through masonry walls and fire rated partitions shall be sleeved and sealed with 3M Fire Sealant System fire stopping to prevent damage from moisture, insects and the spread of fire.
 - M. A system's wiring shall not share raceways with another system's wiring.
 - N. Cables shall enter control panels, power supply cabinets, junction boxes and other devices through appropriate openings with fittings designed to prevent damage or abrasion.
 - O. All conductors shall be tested for grounds and shorts.
 - P. Splices and terminations shall be kept to a minimum. When terminations are required, crimp type fittings within enclosure shall be used.
 - Q. "T -tapping" of detector circuit wiring shall not be permitted.
 - R. All detector alarm initiating loop circuits shall be measured for resistance and readings shall be recorded on the as-builts.
 - S. Spray paint a portion of junction box white to indicate box is for special systems.

3.6 LABELING

- A. Identify the panel and circuit number within the cabinet served.
- B. Identify the load served on the electrical panel directory.
- C. Cables, detectors, panels, enclosures, addressable modules and auxiliary power supplies shall be labeled indicating system zone, partition or circuit identification and accurately reflected on the as-built drawings.
- D. Color coding of conductors shall be consistent throughout the installation, as follows:
 - 1. DC power circuits shall be red for positive leads and black for negative leads.
 - 2. Alarm initiating loops shall be white for positive conductors and green for negative conductors.

END OF SECTION 28
13 00

SECTION 28 16 00 - INTRUSION DETECTION SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall furnish and install a complete security alarm system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. The system shall be integrated with the Access Control System and the Video Surveillance System.
- C. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of Specification, Division 26 00 00. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- D. The system shall include security for all access into building, including but not limited to doors, roof hatches, windows and interior space motion detection. Card reader access interface must also be provided at all Card Reader locations.
 - 1. The Control System shall be the product of a single manufacturer.
 - 2. Tag all conductors or cables at each end.
 - 3. Installation of security panels.
 - 4. Interconnection of security panels.
 - 5. Installation of new security devices.
 - 6. Full coverage of all windows, doors, roof hatches.
 - 7. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- E. The contractor shall connect this location to the district monitoring station as designated by the owner.
- F. Provide cabling and requisite modules to integrate this system with the Intercom system (Section 27 51 23) to provide messaging for emergency events. Coordinate with other trades.

1.2 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Fire Protection Association Standards:
 - 1. NFPA 70 National Electric Code
 - 2. NFPA 72 National Fire Alarm Code
 - 3. NFPA 101 Life Safety Code
- B. Local & State Building Codes
- C. Requirements of Local Authorities having Jurisdiction
- D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- E. Requirements of American Disabilities Act (Public law 101-336).

- F. Texas Accessibility Standards (T.A.S.)
- G. State Fire Marshall.
- H. Texas Insurance Code.

1.3 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the Security Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
 - 2. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems.
 - 3. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
 - 4. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 - 5. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the Radionics System. No person is allowed to work on the Radionics system without proper manufacturer's certification.

1.4 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Control panel wiring and interconnection schematics.
 - 2. Complete point to point wiring diagrams.
 - 3. Riser diagrams.
 - 4. Complete floor plan drawings locating all system devices.
 - 5. Factory data sheets on each piece of equipment proposed.
 - 6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 - 7. Complete system bill of material.
 - 8. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Digital Monitoring Products, Incorporated (DMP)
2500 N. Partnership Boulevard, Springfield, MO 65803
Telephone (417) 831-9362 FAX (417) 831-1325
- B. **INTRUSION SYSTEM IS EXISTING TO REMAIN, CONTRACTOR TO PROVIDE NEW DEVICES FOR NEW DOOR LOCATIONS.**

2.2 GENERAL COMPONENT REQUIREMENTS

A. Component Enclosure

- a. 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.
- b. 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 tamperers listed for use with the XR550 with Network and Encryption shall be used.

B. 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 Loop Expansion LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the Loop Expansion LX-Bus(es) and Keypad bus are shut down.

C. 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 180seconds.
- 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.
- c. Control unit must be "Flash ROM" updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
- d. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router for SCIF (Sensitive Compartmented Information Facility) applications that is certified by NIST (National Institute of Standards and Technology) for 128-Bit AES Rijndael Encryption communications.
- e. The optional built-in Encrypted Alarm Router shall be capable of compliance with ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.

D. 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.

E. Control Designations

- a. 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.

F. Test Function

- 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.

G. 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:
 - i. ULListed DMP505-12: 12VDC 5 Amp with transformer and enclosure.

H. Software

- a. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
 - i. Direct cable connection interface card
 - ii. Receiver phone line connection
 - iii. Standard phone line connection
 - iv. Ethernet network connection
 - v. Network connection across the Internet
 - vi. Cellular network connection using the 263C or 263H Cellular Communicators
- 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:
 - i. .xls
 - ii. .rtf,
 - iii. .wmf,
 - iv. .qrp
 - v. .txt
 - vi. .csv
 - vii. .htm
- e. The system shall interface with computer software capable of printing custom, filtered reports including:
 - i. All Events
 - ii. Zone Action
 - iii. Arming/Disarming
 - iv. Area Late to Close
 - v. User Code Changes
 - vi. Door Access Granted
 - vii. Door Access Denied
 - viii. Opening/Closing Schedule Changes
 - ix. System Monitors
 - x. System Events.

I. Graphic User Interface (GUI): Entré —Access & Security Management Software

- a. System Features:
 - i. The software shall be available in three package sizes. Contractor shall provide the package size based upon the system requirements.
 - 1. Entré Lite: Shall have 16 doors included, and a maximum of four XR550 Series panels, personnel management, full reports, and event management.
 - 2. Entré Business: Shall have the same features as Entré Lite with the option of expansion to 96 doors maximum and up to 24 XR550 Series panels.
 - 3. Entré Enterprise: Shall have the same features as Entré Business with 96 doors included with the ability to expand to an unlimited number of doors, users and XR550 Series panels.
 - ii. Shall have simple user management, with the ability to import users from existing databases.
 - iii. Shall be able to assign user access by group, facility or other parameters.
 - iv. Shall have drop down lists for devices, user data and other information to facilitate fast and accurate searches.
 - v. Shall be able to view system status in one of a variety of views for simplified alarm monitoring management.
 - vi. Shall have the capability to customize reports for added flexibility.
- J. User Management:
 - i. It shall have the ability to import into Entry from existing systems via standard comma-separated value (CSV) format files. It shall easily add new users, capture and edit their photo for badging or visual verification from within the application.
 - ii. User fields shall be fully customizable. Assign specific rights or events by user or by group. The software shall be able to create effective /expiration time for users, limiting access to only certain times of the day, and only certain days, or for only a defined period of time.
- K. AES Encryption:
 - a. The XR550 provides encrypted data transmission to the monitoring center and is ideal for secure environments where encrypted data is required. Using 128- or 256-bit AES ensures secure data transmission by using a unique alphanumeric passphrase.
- L. Highly Customizable:
 - a. The software shall be extensively customizable to create a system that matches the end user's application's needs.
 - b. Shall define what events are considered "alarms," and what response is required from the system operator.
 - c. Shall be able to tailor user data with up to 20 available user-defined fields.
- M. Hierarchical Views:
 - a. The software shall have the ability to select from four different system views, with the ability to have multiple views open simultaneously. Select the graphical Map view, tabular Event view, or hierarchical Tree view.
 - b. The software shall be able to click on a device or alert to access additional information and process the event. In text-based views, software shall have simple drill downs to allow fast navigation to the desired item.
- N. Powerful Search:
 - a. The software shall employ industry standard SQL database for quick and easy search to identify any desired device or user which is compatible with nearly any database.
- O. Single-System Control:
 - a. The software shall employ a network solution to manage installations and users from any location. A single, unified database means there's one badge, one face or one fingerprint, worldwide.

P. Entré -Access & Security Management Software Optional System Modules:

- ENTRE-4DR Additional 4-Doors
- ENTRE-16DR Additional 16-Doors
- ENTRE-32DR Additional 32-Doors
- ENTRE-64DR Additional 64-Doors
- ENTRE-STD Standard Client
- ENTRE-WEB Web Client
- ENTRE-MAPS Alarm Graphics
- ENTRE-AUTO Automation Module
- ENTRE-DVR DVR Module
- ENTRE-PART Database Partitioning
- ENTRE-LANG Multiple Language module
- ENTRE- LDAP Lightweight Directory Access Protocol
- ENTRE-IMAGE Personnel Image Capture
- ENTRE-BADGE Badge Designer
- ENTRE-SIGN Signature Capture

Q. Optional System Modules Features:

- a. Shall be able to Point-and-click control of alarms and devices.
- b. Shall have a modular design to enable customization, with optional modules for added features.
- c. Shall be available in French, Spanish, or English, with dual-language operation mode.
- d. Shall have full reporting, including at-a-glance dashboard graphics and charts or traditional tabular displays, with the ability to produce reports in a variety of file types.
- e. Shall have DVR integration.
- f. Shall have image management of users and event photos.
- g. Shall have a custom badge builder and video badging.

R. Door Modules:

- a. The software shall allow for the addition of additional doors to support Entré Business or Enterprise systems.

S. Alarm Graphics:

- a. The software shall allow for the addition of four more doors to support Entré Business or Enterprise systems.
- b. Shall have the ability to give graphical representation of events and alarms at-a-glance and give feedback of system status.
- c. Shall have the capability to upload an unlimited number of graphical images of protected facilities in a variety of file formats.
- d. System maps are linked from level to level, allowing drill down from a macro view to a specific room or area.
- e. View alarm status at every level of zoom.
- f. User-defined layers representing different alarm types allow you to customize the graphical interface to meet application needs.
- g. Once loaded, it shall have the ability to plot alarm devices on the graphics using drag-and-drop selections from a hierarchical list of hardware. Identify the areas on your site maps, defining them by Classification, Entrances, Zones, and Partitions.
- h. It shall have total picture-based monitoring and control of the system. It shall from facility-wide views be able to click to zoom in on any area of the facility and view the real-time status of any device.
- i. The software shall be able to click on the alarm display icon to acknowledge an alarm or to request additional information.

T. Automation Module:

- a. The software shall be able to give advanced users the power to create automated system actions.
- b. The software shall be able to define automatic responses to any system alarm or events. These include generating a report, generating an alert email, or sending commands to selected devices.
- c. Shall be able to create scheduled system actions to run once at a specified time and date, or scheduled events that repeat at user defined time and date intervals.
- d. System automation enables configuration of unattended activities, freeing system managers from many routine responsibilities.

U. DVR:

- a. The software shall be able to quickly connect to a DVR to review video based on a received alarm from a control panel.
- b. Connect to DVR from a graphical map of the area to review activity.
 - i. Verint
 - 1. NetDVR I, firmware 6.47.x or higher
 - 2. NetDVR II, firmware 8.7.x or higher
 - 3. EdgeVR, all firmware versions
 - ii. 3VR
 - 1. E-Series
 - 2. P-Series
 - 3. 5-Series
 - 4. Server Class
 - iii. March Networks
 - 1. 3204 Digital Video Recorder (3000 Series)
 - 2. 4000 C NVR (4000 C Series)
 - iv. Dedicated Micros
 - 1. All NetVU compatible series 2 and 3 DVRs

V. Database Partitioning:

- a. The software shall allow system information to be contained in a single unified database allowing system managers to limit user access to only certain areas of the database to partition the information.
- b. The software shall allow organization of data into separate collections by physical area, hardware types, events, or other parameters.

W. Multi-Language:

- a. The software shall support multiple languages enabling multiple operators to select a language during their login process. The software shall allow text shown both in English and a second selected language.
- b. Available languages shall include:
 - i. English
 - ii. French
 - iii. Spanish

X. LDAP (Lightweight Directory Access Protocol):

- a. The software shall provide LDAP single sign-on for users, enabling them to use one password to access multiple system services.
- b. System user information can be imported directly from an existing LDAP Tree.

Y. Badge Image Capture:

- a. The software shall allow the transfer of pictures of users from a digital camera directly onto a badge. Select a TWAIN source to capture the image to allow up to date images on employee badges.

Z. Badge Designer:

- a. The software shall have the ability to create one or more badge designs, customizing badges by facility, user level, or other parameters.
- b. When badging employees or visitors, select the desired badge template from library. The template automatically populates with the appropriate data, ready for printing.

AA. Signature Capture:

- a. Shall use a signature capture device to provide the ability to capture employee or visitor signatures and store the images.

BB. Reporting Dashboard:

- a. The software shall have interactive graphics for instant feedback on system activity.
- b. The software shall be able to choose a number of charts for functions such as Access Granted / Denied at a particular access point or an entire facility to get a snapshot of activities within any defined time period.
- c. Shall have ability to filter through user, activity, or event data to narrow results and show precisely the information needed.
- d. Shall have the ability to view reports from within the application, or saved and exported to PDF, HTML, XLS, CSV, or XML format for distribution.
- e. Shall automate custom reports to generate and distribute each day at desired times.

CC. Control Panel Capability

- a. The basic control panel shall provide:
 - i. Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
 - ii. Temporary user codes that can be entered with a finite date and specific time to expire.
 - iii. Sixteen (16) independent door/keypad addresses, each with four zones.
 - iv. A total door access granted event buffer of at least 10,000 events.
 - v. Anti-passback access control selectable by area and user.
 - vi. A total of at least 99 programmable Schedules for output relay schedules, area schedules, door schedules, holiday schedules, and user profiles. The same schedule may be assigned to more than one area, door, or output, making them reusable. There shall be at least two schedules per user profile with up to four profiles per user. Up to 8 Schedules per user, per door, per area, and per output.
 - vii. Thirty-two Areas (32) individual reporting areas XR550.
 - viii. Built-in bell and telephone line supervision.

- b. The networked control panel shall provide:
 - i. All of the above features.
 - ii. Require two-man access code or credentials. Require two user code entries to disarm and/or allow door access to this area.
 - iii. 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.
 - iv. 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.
 - v. Early Morning Ambush. Must disarm a second time within a programmed period of time or an early morning ambush silent alarm is sent.
 - vi. Bank Safe & Vault features. Schedules set for this area and the time of day cannot be changed while the area is armed.

DD. The XR550 encrypted control panel shall provide the entire above plus:

- a. All of the basic and network features listed plus.
- b. Built-in Encrypted Alarm Router.
- c. Certified operation that meets NIST (National Institute of Standards and Technology) standards for 128-bit and 256-bit AES (Advanced Encryption Standard) Encryption.
- d. Certification that encrypted panel is capable of meeting ICD 705 Chapter 7 Intrusion Detection Systems (IDS) standards.
- e. Certification that encrypted panel is capable of meeting UL 2050 standards.
- f. Card plus Pin for High security card access is provided by the Card Plus Pin feature that requires both a card read and a PIN (4-6 digit user ID) entry for arming/disarming and access by area. This Card Plus Pin operation complies with the ICD 705 requirement for dual id authentication and operates with a DMP Prox Keypad and a HID ProxPro reader with the keypad connected to a DMP Wiegand Interface module.
- g. Panic Test allows the panic zone test verification and failure results to be sent to the central station receiver.
- h. Passphrase of 8-16 characters to validate encryption between the XR550 with Encryption and the Central Station Receiver.

2.3 FUNCTIONAL DESCRIPTIONS

A. 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 506 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, cellular communications paths.
- 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.

B. Input/Output Capacity

- a. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 506 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 506 auxiliary relays (Form C rated at 1.0 Amp at 30VDC).
- c. The panel shall also provide 99 programmable output profiles for 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.
- d. The system shall be capable of supporting and controlling up to 232 Z-Wave devices and up to 20 Z-Wave Favorites for group control.

C. User/Authorization Level Capacity

- a. 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.

D. Keypads

- a. 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 or 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 non- shielded 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.

E. 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. Each zone shall function in any of the following configurations:
 - i. Night
 - ii. Day
 - iii. Exit
 - iv. Fire
 - v. Supervisory
 - vi. Emergency
 - vii. Panic
 - viii. Auxiliary 1
 - ix. Auxiliary 2
 - x. Fire Verification
 - xi. Cross-Zone
 - xii. Priority
 - xiii. Arming

F. Communication

- a. The system shall be capable of signaling to as many as 8 remote monitoring station receivers. Seven (7) of the eight (8) paths shall be capable of being assigned as either a "primary" or "backup" path. In such a manor the system shall have multiple primary paths to multiple remote monitoring stations as well as multiple backup paths to multiple monitoring stations.
- b. The system shall employ Adaptive Technology that allows a Backup communication path programmed for Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable. This creates a seamless transition for communication.
- c. The system shall be capable of dialing up to (2) 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 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 sequence 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.

- d. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least one other standard industry format.
- e. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

G. Network Communication

- a. The control panel shall be capable of asynchronous network communication with a retry time between 2 and 240 minutes and a fail time of 2 and 240 minutes. 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. The control panel shall employ adaptive communication technology. Adaptive Technology allows a Backup communication path programmed to use Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable, creating a seamless transition for communication of messages. Select Adapt when programming the Checkin option. This allows a system to be fully supervised even if a path fails, while also keeping wireless charges low when the network is good.
- c. Network communication between the control panel and the receiver shall be in a proprietary communication format.
- d. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
- e. Underwriters Laboratories (UL) shall list network communication by the control panel for Standard or Encrypted Line Security.
- f. The control panel shall be capable of two-way network communication using standard Ethernet 10BaseT in a LAN, WAN, or Internet configuration.
- g. The control panel shall be capable of communication by means of a 128-bit or 256-bit AES (Advanced Encryption Standard) Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with an SCS-104 line card or SCS-VR.
- h. The control panel shall be capable of meeting ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.
- i. The control panel shall be capable of sending text messaging to up to three Cellular Phone Numbers using cellular communications.
- j. The control panel shall be capable of sending the following SMS messages:
 - i. Zone Alarms by Zone Name
 - ii. Zone Troubles by Zone Name
 - iii. Zone Bypass by User
 - iv. Arming (Closings) by User
 - v. Disarming (Openings) by User
 - vi. Late to Close
 - vii. AC Power Trouble and Restoral
 - viii. System Low Battery
 - ix. Ambush
 - x. Abort, Cancel and Alarm Verified by User
 - xi. Check-in by user

H. Cellular Communications

- a. The control panel shall have the capability to communicate with a plug-in cellular HSPA+ communicator model number 263H or CDMA communicator model number 263C that shall plug into the control panel J24 connector which shall supply full data communication and power to the 263H or 263C cellular communicator. The cellular communicator shall be capable of communicating full panel alarm and auxiliary messages to the DMP SCS-1R Central Station or SCS-VR Receiver as well as SMS text messaging to a PC, PDA, or Cellular telephone.

- b. The control panel shall be capable of sending the following SMS messages:
 - i. Zone Alarms by Zone Name
 - ii. Zone Troubles by Zone Name
 - iii. Zone Bypass by User
 - iv. Arming (Closings) by User
 - v. Disarming (Openings) by User
 - vi. Late to Close
 - vii. AC Power Trouble and Restoral
 - viii. System Low Battery
 - ix. Ambush
 - x. Abort, Cancel and Alarm Verified by User
 - xi. Check-in by user
- I. 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 SCS-104 installed in an SCS-1R receiver.
 - b. The receiver SCS-104 shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver SCS-104 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 SCS-104 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 SCS-104 in Remote Link using the Trap Query function.

2.4 INTEGRATED INTRUSION ALARM AND ACCESS CONTROL OPERATION

- A. Access Authority Levels
 - a. 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.
- B. Door Open Schedule Override
 - a. 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.
- C. Common Area
 - a. 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.
- D. Area Access Control
 - a. The system shall be capable of integrating area access control capability where specified into the same control panel with the ability to have up to 10,000 user credentials. User access is limited to custom profiles and/or schedules. Anti-passback shall be available. The networked version shall support a Two-Man Rule feature. The system shall support up to sixteen (16) access doors, connected to the system using a manufacturer-approved interface module.
 - b. Area door access products shall meet or exceed features offered by the following products:

- i. Keypad reader/administration device – DMP Model 7063/7063A, 7073/7073A, 7163/7173, 7872, 7873
- ii. Wiegand Interface – DMP Model 734, 734N, or 734N-WIFI
- iii. Reader – DMP Model PP-6005B, Model PR-5455, Model MP-5365
- iv. Cards or credentials – DMP Model 1326, DMP Model 1306P, DMP Model 1346, DMP Model 1386

E. Access Control Equipment

- a. Access Control equipment shall communicate to the system by way of the control panel keypad bus. The equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 11.5 of this document.

F. Early booming Ambush

- 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.

G. Two-Man Rule

- a. 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.

H. UL Bank Safe & Vault Operation

- a. 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 and Vault areas shall not be able to be bypassed or force armed.

I. Panic Button Summary Test

- 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.

J. One-man Walk Test

- a. A special code is also available for installers to test the system. The One-Man Walk Test feature allows a single technician to check the panel response to burglary, fire, panic, and supervisory zones.

K. Multi-lingual Display Option

- a. The system shall be programmed to display the User Menu and Status Display text in multiple

languages.

- L. User Inactivity Audit
 - a. System shall allow user code inactivity to notify the central station after a programmable period of days of no activity. The system shall be programmable from 0-365 days.
- M. Lock Down
 - a. The system shall for emergency situations, a lock down command can be issued from the keypad menu or via remote command and locks all doors designated as public.
- N. Communication Function Diagnostics
 - a. The system shall have enhanced diagnostic menu that enables technicians to check network and cellular communication status and cell signal strength from the keypad.
- O. GUEST Operation
 - a. The system shall be capable of in the Home/Sleep/Away with Guest House operation, create up to three separate systems (main and two guests). Keypads in each system can selectively arm the perimeter, interior, or bedrooms for only their protected areas. Main system users can add authorized users to all protected areas, but guests can add users only for their protected system.

2.5 FALSE ALARM REDUCTION FEATURES

- A. 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.
- B. Exit Error Alert and Reporting
 - a. 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.
- C. 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.
- D. Remote Annunciation
 - a. 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.
- E. Abort Reporting
 - a. 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.
- F. System Testing
 - a. 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.
- G. Ambush Code
 - a. 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.

H. Two-Button Panic Feature

- a. 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.

I. Fire Verify Zones

- a. 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.

J. Cross-Zoning Protection

- a. 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.

K. Swinger Zone Bypassing

- a. 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.

L. Recently Armed Report

- a. 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.

M. Transmit Delay

- a. 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.

N. Call Waiting Cancel

- a. The system shall be capable of being programmed to cancel call waiting any time the panel dials the receiver number to send a report.

O. Cancel/Verify

- a. The system shall be capable of sending either a Cancel Report or Verify Report to the Central Station to signify that the end user has Canceled an Alarm or Verified an Alarm condition. Also, the system shall be programmable to instead of Cancel/Verify show "IS THIS A FALSE ALARM? NO YES". If YES send validation of alarm to Central Station, if NO send alarm cancels.

2.6 Must meet ANSI/SIA CP-01-2010 Standards for False Alarm Reduction

- A. The system shall be capable of meeting ANSI /SIA CP-01-2010 Standards for False Alarm Reduction.
- B. Shall Meet Exit Delay Standards
 - a. Default - 60 seconds (Minimum 45seconds)
 - b. Progress Annunciation - different sound last ten seconds ofdelay
 - c. Automatic Restart of running exit delay, one time upon re-entry
 - d. Recent Closing - signal sent if alarm within 2 minutes of Exit time expiration (change from 5min)
 - e. Exit Error - Immediate local alarm and entry delay starts
- C. Shall Meet Entry Delay Standards
 - a. Default - 30 seconds (Minimum 30seconds)
 - b. Pre-Warning Silenced - after first digit code entry
 - c. Cancel Message sent if disarmed after alarm sent
- D. Shall Meet Fail-to-Exit Standards
 - a. When perimeter and exterior areas are defined and the user does not leave the building before the system arms, the system only arms the perimeter and leaves the interiorunarmed.
- E. Shall Meet Automatic Restart Standards
 - a. The system shall stop the Exit countdown once and restart it to allow the user to pick up a forgotten jacket or briefcase and exit the building without sending an alarm to the central station.

2.7 BURGLARY CONTROL SPECIFICATIONS

- A. Burglary Standards
 - a. The Burglary system shall be listed as a Power Limited Device and be listed under the standards in the table below. Each system shall besupplied with complete details on all installation criteria necessary to meet all of the listings.
 - b. Burglary Listings
 - i. UL 1023 Household Burglar Alarm System Units
 - ii. UL 1076 Proprietary Burglar
 - iii. 1610 Central Station Burglar Alarm Units
 - iv. UL 1635 Digital Burglar Alarm Communicator System Units
 - c. U.S. Government Standards
 - i. Meets ICD 705 Chapter 7 Intrusion Detection Systems
 - ii. Meets DoD/NUT SCIF Standards
 - iii. Meets ANSI/SIA CP-01-2010 False Alarm Reduction
 - d. Canadian Burglary Listings
 - i. ULC C1023 Household Burglar Alarm System Units
 - ii. ULC/ORD-C1076 Proprietary Burglar
 - iii. ULC 5304 Central Station Burglar Alarm Units
- B. Area System Mode
 - 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 thirty-two (32) 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.
 - d. The Encrypted system shall have the feature of Card Plus Pin by area High security card access is provided by the Card Plus Pin feature that requires both a card read and a PIN (4-6 digit user ID) entry for arming/disarming and access by area. This Card Plus Pin operation complies with the ICPG 705 requirement for dual id authentication and operates with a DMP Prox Keypad and a HID ProxPro reader with the keypad connected to a DMP Wiegand Interface module.
- C. Home/Sleep/Away
- a. The system shall be capable of being configured in a Home/Sleep/Away configuration for Residential applications. The system shall consist of a Main House system and up to two Guest House systems within one single control Panel with each house being controlled with its own keypad as if it were separate alarm systems.
- D. All/Perimeter
- a. The system shall be capable of being configured into the All/Perimeter configuration to enable the selective arming of both the interior and perimeter when armed "All" or arming just the perimeter devices if arming "Perimeter".
- E. Zones
- a. The system shall have a minimum of eight (8) grounded burglary zones available from the control panel, and two floating ground powered zones for two wire type compatible smoke detectors. The system shall have the ability to expand using the panel's keypad bus for up to sixty-four additional zones. The system shall also have five built-in zone expansion bus (LX500 – LX900) for an additional 500 zones of expansion. The system shall have the ability to integrate up to 500 wireless zones for a total of 574 zones overall.
- F. Burglary Equipment
- a. Burglary detection equipment shall communicate to the system by way of the control panel loop expansion bus or 900MHz bi-directional spread spectrum receiver. The detection equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in this document.
- G. Z-Wave Equipment
- a. The system shall be capable of 232 Z-Wave devices by means of the use of the model 738Z module. The system shall have the capability of up to 20 Z-Wave favorites for grouping Z-Wave devices into a favorite response or control.

2.8 ACCESS CONTROL SPECIFICATIONS

- A. The access control system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.
- a. Access Control Listings
 - i. UL 294 Access Control System Units
 - b. U.S. Government Standards
 - i. Meets ICD/ICS 705 Chapter 7 Intrusion Detection Systems (IDS)
 - ii. Meets DoD/NIST SCIF Standards
- B. Keypad
- a. The system shall display a message at any keypad when any system area remains disarmed past the scheduled closing time. The message shall be displayed at one minute past the scheduled closing time. A pre-warn tone shall also begin sounding. If the system

- is not armed or a schedule extended within ten minutes past the scheduled closing time, the system shall provide the option of sending a Late to Close report to the central station.
- b. The keypad shall include a door strike relay capable of sending a report to the central station when activated.
 - c. The keypad shall be capable of proximity arming and disarming functions.
 - d. The keypad shall display red backlighting when in alarm condition notifying an individual of an unacknowledged alarm condition.
 - e. The keypad shall annunciate when canceling an alarm condition the words "Cancel" or "Verify" to allow the end user the ability to cancel a user generated alarm or to select verify to send a message to the central station that the alarm has been verified by the end user and to send emergency response personnel. This is to comply with Alarm Verification.
- C. The system shall be capable of integrating area access control capability where specified into the same control panel with the ability to have up to 10,000 user credentials. User access is limited to custom profiles and/or schedules. Anti-passback shall be available. The networked version shall support a Two-Man Rule feature. The system shall support up to sixteen (16) access doors, connected to the system using a manufacturer-approved interface module.
- D. Area door access products shall meet or exceed features offered by the following products:
- a. Keypad reader/administration device – DMP Model 7063/7063A, 7073/7073A, 7163/7173, 7872, 7873
 - b. Wiegand Interface – DMP Model 734, 734N, or 734N-WIFI
 - c. Reader – DMP Model PP-6005B, Model PR-5455, Model MP-5365
 - d. Cards or credentials – DMP Model 1326, DMP Model 1306P, DMP Model 1346, DMP Model 1386
- E. Access Control Equipment
- a. Access Control equipment shall communicate to the system by way of the control panel keypad bus. The equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in this document.

2.9 COMPILED DETECTION EQUIPMENT LISTING

- A. 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:
- a. Ceiling mounted, 360-degree dual technology, infrared sensors/microwave motion sensors. Optex Model FX-360 (PIR) Ceiling mount, White
 - i. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
 - ii. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 - iii. Contractor to provide a dedicated POPIT for each motion detector on the project.
 - b. Wall mounted, MX-40 40' x 40' (PIR) Microwave Detectors.
 - i. Low Profile Bracket for directional mounting to standard 3-1/2" and 4" electrical backboxes.
 - ii. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 - iii. Provide model correct protective wire cage in gymnasiums.
 - iv. Contractor to provide a dedicated POPIT for each motion detector on the project.
 - c. Glass Break Detector
 - i. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 - ii. Provide model correct protective wire cage in gymnasiums.

- iii. Sentrol 5820A
- iv. Contractor to Provide dedicated POPIT for each room of glass break detectors on the project.
- d. Door Contacts are provided in Section 28 13 00 – ACCESS CONTROL SYSTEM
- B. Notification equipment shall be control panel activated by way of the supervised bell output module. The equipment shall meet or exceed features offered in the following products:
 - a. Network Transient Suppressor - DMP Model 270
 - b. Trouble Sounder - DMP Model 277
 - c. Bus Splitter/Repeater Module - DMP Model 710
 - d. Door Contact - DMP Model SM-20WG (surface applications - requires DMP zone expander)
 - e. Output Expansion Module - DMP Model 716
 - f. Graphic Annunciator Module - DMP Model 717
 - g. Dual Phone Line Module - DMP Model 893A
- C. Other product types shall connect directly to zone expansion modules such as:
 - a. Addressable - - DMP Models 521LX, 521LXT, 850S/711, 850D/711, 2W-BLX, 2WT-BLX
 - b. Non-Addressable - DMP Models 521B, 521-BXT, 850S, 850D
 - c. Addressable - DMP Model 711
 - d. Addressable - DMP Models 714, 714-8, 714-16
 - e. Addressable - DMP Models 712-8
 - f. Addressable - DMP Models 715, 715-8, 715-16
 - g. Manual Fire Alarms - DMP Models 850S, 850D
- D. Power supply and transformer 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:
 - a. Power Supply - DMP Model 505-12, 115 VAC, 12 VDC
 - b. Power Supply - DMP Model 505-12LX, 115 VAC, 12 VDC
 - c. Power Supply - DMP Model 505-12L 12 VDC
 - d. Transformer - DMP Model 327, 16.5 VAC 50 VA, Plug-In
 - e. Transformer - DMP Model 322, 16.5 VAC 56 VA, Wire-in
 - f. Transformer - DMP Model 323, 16.5 VAC 56 VA, Wire-in
 - g. Transformer - DMP Model 324, 16.5 VAC 100 VA, Wire-in
 - h. Transformer - DMP Model 324P, 16.5 VAC 100 VA, Wire-in

2.7 WIRING

- A. All wiring shall be by the manufacture's specifications. All cable shall be shielded as required.
- B. All 120v Power shall be furnished by the Division 26 00 00 contractor.
- C. All Security Conduit as shown on the drawings shall be furnished by the Division 26 00 00 contractor as part of their scope of work.
- D. Coordination with the Division 26 00 00 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- E. All systems shall be connected to an emergency power source as available.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Telephone Cable: Provide a 4 pair Category 5E/6 telephone cable from the Master Control Panel to the Telephone Equipment Room.
- I. Each motion sensor is to be connected into a dedicated POPIT module for point identification.
- J. Each set of magnetic door contacts that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entry areas to be connected into separate POPIT modules for separate identification.
- L. Motion detectors and door contacts shall not share one POPIT module.
- M. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.

3.2 SYSTEM OPERATION

- A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:
 - 1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.

2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
3. The remote signaling tie connection shall be activated at the Owner's approved central security monitoring location and/or other Owner designated location.
4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

3.3 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.

3.4 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.5 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.6 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

SECTION 28 23 00 – SECURITY CAMERA SURVEILLANCE SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide a complete and tested digital video surveillance system including cameras, cabling, digital image storage, integration, and accessibility with Owner's Local/Wide Area Network (LAN/WAN), Internet accessibility thru remote view application software and simultaneous user access capability. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Specifications and Drawings.
- B. The system shall be Non-Proprietary in nature and be available through multiple distribution channels in the Austin Marketplace. System that are manufactured and installed by a factory office and are not available through multiple distribution channels.
- C. Provide all electronic hardware and coordinate with the building's LAN/WAN. The contractor shall coordinate with other system vendors, where appropriate, to facilitate equipment installation, scheduling, protection of equipment and access to the project site in order to provide the Owner a substantially complete project in a timely manner.
- D. All materials and methods described below shall be provided for new cameras that will be required. Owner will provide New NVR(s), Licenses and cameras as required for a fully functioning system.
- E. Provide all licensing and software required for a turnkey installation for all devices shown on the drawings and within this specification.
- F. Contractor shall integrate the Video Surveillance system with the Intrusion Detection system and the Access Control system. Coordinate with other trades. Provide all licenses required.
- G. Contractor shall provide new acoustic ceiling tiles that match existing ceiling tiles where existing cameras have been removed.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. The Video Surveillance System Installer shall be licensed and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the installation of Digital Video Surveillance Equipment.
 - 2. The contractor shall be certified by the manufacturer in all aspects of design, installation and testing of the products described herein. Each contractor shall furnish with their proposal a letter from the manufacture indicating they are a dealer in good standing.
 - 3. The contractor must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures, and utilize the authorized manufacturer components and distribution channels.
 - 4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The contractor shall own and maintain tools and equipment necessary for

successful installation and testing of video surveillance distribution systems and have personnel who are adequately trained in the use of such tools and equipment.

5. The installing contractor must have a permanent office within a 75-mile radius of the project site and be an approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.
6. The proposing contractor and the installing contractor must be the same company.
7. A resume of qualifications shall be submitted with the Contractor's proposal indicating the following:
 - a. A list of five recently completed projects using the product proposed of similar type and size with contact names and telephone numbers for each.
 - b. A list of test equipment proposed for use in verifying the installed integrity of metallic cable systems on this project.
 - c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who shall be assigned to this project.
 - d. A list of technical product training attended by the contractor's personnel that shall install the video surveillance system shall be submitted.
 - e. Any subcontractor who shall assist the video surveillance contractor in performance of this work shall have the same training and certification as the video surveillance contractor.

- B. The Owner's representative reserves the right to reject all, or a portion of the work performed, either on technical or aesthetic grounds.

1.3 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Local Building Code
 2. Local Electrical Code
 3. NEC National Electrical Code
- B. Other references:
1. TIA/EIA-568-A - Commercial Building Telecommunications Wiring Standard
 2. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
 3. TIA/EIA-606 - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 4. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
 5. TIA/EIA TSB 67 - Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 6. ISO/IEC 11801 - Generic Cabling Standard
 7. EN 50173 - Generic Cabling Standards for Customer Premises
- C. Governing Codes and Conflicts:
1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.4 SUBMITTALS

- A. The video surveillance system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer
 2. Product Literature: Complete manufacturer's product literature for all electronics, cable, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Architect/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
 3. Testing: Proposed Contractor test result forms, a list of instrumentation to be used for systems testing.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the Video Surveillance installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- B. Certifications/Licensing: The contractor shall submit all of the following certifications/licensing and all must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
1. State Licenses as applicable to this system
 2. Manufacturer's Authorized Dealer Certification
 3. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)
- C. Shop Drawings: Submit the following items, for Owner review and approval:
1. Proposed cable routing and power circuit grouping plan.
 2. In addition to the above listed items, the submitted drawings shall show the following:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed
 - d. Quantity of cable passing through each sleeve
 3. Conformance: For items which are being provided exactly as specified, provide a letter stating the item description and model number, and that it is being provided as specified.
 4. Drawing Compliance: A letter shall be provided stating that the Video Surveillance installer complies with the ENTIRE project drawing, including all general keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- D. Closeout Submittals
1. Final payment of the contractor will not be authorized until the complete documentation specified herein is delivered to the owner. 10% retainage of the entire project will be withheld until receipt of this information.

2. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. During this test, the owners service provider shall install bar codes on each device to enter them into the district's service program.
 - c. Include the Name, address, and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as built") set of approved shop drawing prints that have been revised to show each and every change made to the security camera system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the Security Camera System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - g. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCAD 2013 or later. Provide the Owner with electronic versions of the as-builts on USB drive.
 - h. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - i. A hard copy printout of the system software database and an electronic version (on USB drive) of the system program and database with all required passwords, as installed at the time of acceptance by the owner.
 - j. A copy of the manufacturer's warranty on the installed system.
 - k. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - l. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
 - m. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The cabling shall be installed according to the requirements of the manufacturer and the Project Documents Division 27 10 00, utilizing material meeting all applicable standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- B. Materials shall be listed. No substitutions allowed unless approved by the owner prior to installation.
- C. Testing: the system shall be tested 100% at specified performance after installation by the Contractor.
- D. Cameras shall be strategically placed on the interior and exterior of the building and require confirmation prior to installation.
- E. Location shall include, but not be limited to:
 - i. All building entry points
 - ii. Staff parking areas
 - iii. Main Reception Areas
 - iv. Library
 - v. Cafeteria/Commons area
 - vi. As required for General Corridor Coverage

2.2 DATA CLOSET (MDF/IDF) Equipment Racks

- A. Equipment Racks. Install new NVR(s) in the MDF. Coordinate mounting location with the owner prior to installation.

2.3 SYSTEM ACCESS

- A. Architecture: The video capture, storage and distribution of images shall be integrated using a series of networked computer systems hereafter referring to Network Video Recorders (NVR). Users of the system shall be able to connect to the Image Servers across the network to retrieve both live and archive images on their computer system. Users shall be able to access the NVR(s) from any computer connected to the network even if the network is the Internet.
- B. Communication Protocols: The network protocol used to connect to the Image Servers shall be Transmission Control Protocol/Internet Protocol (TCP/IP). The application protocol used to communicate to the Image Servers shall be
- C. Access Software: software required to access the system shall be available to the owner at no charge via the manufacturers' website or by the installing contractor. It is agreed that once the remote view license is purchased the owner will not have to purchase additional.
- D. Number of Users: The system shall allow at least 25 simultaneous users to access any Image Server at any time from any location. Each user shall be able to operate and view the system independently and without interrupting or conflicting with the activities other users are performing.

2.4 SYSTEM MAINTENANCE

- A. Archive Maintenance: The system shall be capable of automatically erasing old images no longer needed without intervention from an operator regardless of the length of time images are stored.
- B. Power-off Recovery: The system shall be able to recover fully from a power loss to the

system hardware without the aid of an uninterruptible power supply (UPS) or an operator.

- C. Network Connection Recovery: The system shall be able to recover fully when the network connection is returned without the aid of an operator.
- D. Archiving with No Network Connectivity: The system shall be able to continue to archive images normally, for an indefinite amount of time, when the network connection to the computer is not operational.

2.5 DIGITAL NETWORK VIDEO RECORDERS (NVR)

- A. Standard Hardware Components: Except for custom video capture hardware, Image Servers must employ industry standard PC architecture, and must be comprised of replaceable standard parts including:
- B. The contractor shall provide and install Video Insight system servers for a Unified platform. Intel® Xeon® Silver 4210 2.2 GHz or better, 16 GB of RAM or better, 64-bit operating system, 80 GB SATA II hard drive or better for OS, Security Center applications, and Archiver database storage (when using a local Archiver database), with a minimum of 15 GB of free disk space to install a Security Center server, GbE network interface card, Standard SVGA video card
 - Up to 50 cameras or 50 Mbps and 64 readers, Readers spread across 5 HID
1000/Synergis™ Cloud Link, 5,000 cardholders
 - Up to 100 cameras or 200 Mbps and 200 readers, Readers spread across 40 HID
V1000/Synergis™ Cloud Link, 40,000 cardholders
- C. Acceptable Manufacturer for Network Video Recording Units
 - a. GENETEC
 - b. **NOTE: It is the Contractor's responsibility to provide additional NVRs as required where the camera view count exceeds 64 per NVR.**
 - c. **NOTE: It is the Contractor's responsibility to provide all necessary licenses required for the installation.**
- D. Contractors shall label all NVR units (front and back) as per district naming convention. Coordinate name of NVR units with owner prior to any NVR configuration or installation of equipment.
 - a. Contractor to create and assign pools for each NVR. Pools drive letters shall be labeled "I".
 - b. Contractor to load and unload ISCSI initiator on NVR and configure the NVR to communicate with the storage array.
- E. Provide all required mounting hardware and adaptors as required to properly install NVRs in the MDF / IDF rack.

2.6 CAMERAS

- A. Camera Signal: Video cameras attached to the system should output the NTSC video standard.
- B. Cameras Approved Manufacturers: **Hanwha**.
 - a. **Multi sensor:** Hanwha PNM-C16083RVQ

- b. **Exterior Dome:** Hanwha XNV-C6083R
 - c. **Interior Dome:** Hanwha XND-C6083RV
 - d. **Interior 180°:** Hanwha PNM-C12083RVD
 - e. **Contractor is responsible for providing all necessary equipment to mount to different ceilings, walls or finishes.**
- C. Field Of View Determination by the contractor as necessary for all camera locations shall be performed at no additional cost to provide the view desired by the owner.
- D. Contractor shall coordinate all final camera views and locations with owner for final approval.
- E. Contractor shall be contractually bound to return to the site two times, during the first three months of the building normal day to day operations, to adjust cameras views after the owner's staff has had time to view the system and discover any locations where desired adjustments are needed.
- F. All exterior cameras shall have wiring routed through mounting bracket to serve camera. No exterior wiring or armor flex shall be visible from the outside.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Cable Pathway:
 - 1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 25 cables or less, with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five (5) foot intervals. Plenum rated cable ties shall be used in all appropriate areas. The Contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all cables.
 - 2. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
 - 3. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems, or any environmental sensor located in the ceiling air space.
- B. Provide all penetrations and all conduits as necessary for installation of CCTV installation.
- C. All exterior penetrations require necessary weatherproofing to avoid moisture penetration.
- D. All outdoor cable runs underground shall be rated for underground use.
- E. Provide all power circuits required for the NVR's and camera power supplies.
- F. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. The contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- G. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.

- H. Provide three-sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.
- I. Install new conduit on portable pipe supports – (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.
- J. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)
- K. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.
- L. General:
 - 1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
 - 2. On the Switch side, cable must be terminated at patch panel and jumper from patch panel to the switch.
 - 3. On Camera side, cable will terminate at biscuit – RJ45 keystone with jumper from biscuit to camera.
 - 4. All cables must be handled with care during installation so as not to change performance specifications.
- M. All exposed cabling shall be installed in conduit and painted to match surrounding wall color.
- N. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.
- O. Cable Support:
 - 1. All wire not installed inside the conduit shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. If the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
 - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
 - 5. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
 - 6. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO ENSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE**

**INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON
THE INSTALLED WIRING.**

- P. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC, local, and state requirements.
 3. Minimum conduit size shall be 3/4" (19.1 mm). Install conduit per engineered shop drawings.
- Q. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical.
- R. Contractor is responsible for all electrical work required on this project for connection of NVR, cameras, conduit, viewing stations and power supplies. The contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a security camera system at each campus listed.

3.2 DOCUMENTATION

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. The labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables, including power, shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- D. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

3.3 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended

products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.

- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

3.4 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

3.5 WARRANTY

- A. Guarantee and warrant all equipment provided for a period of **3 years (cameras shall be for 5 years)** following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration.
- B. All such warranties shall include all parts (NVRs, and Power Supplies).
- C. Labor and all other costs necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion.

3.6 EQUIPMENT RACK CONFIGURATION

- A. Equipment Racks:
1. Equipment racks shall be assembled and mounted in locations shown on the drawings or as required. Each rack shall be securely mounted to the floor and braced to the wall with a cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb. The racks and cable tray shall be grounded in accordance with NEC requirements.
 2. Security camera equipment to be mounted in floor mounted network rack provided and installed by data contractor. Refer to data floor plan for location of rack in headend room.
- B. Cable Placement: Cable installation in the wiring closet must conform to the Project Drawings. All cabling shall be routed to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty later by maintaining a working distance from these openings.
- C. Cable shall be routed as closely as possible to the ceiling, floor, or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.
- D. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

3.7 WARRANTY

- A. Guarantee and warrant all equipment provided for a period of 1 year following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration. Manufactures extended service plan as specified above applies to the Digital Video Recorders for a period of 3 years.
- B. The system and all devices shall be incorporated into buildingreports.com.

END OF SECTION

SECTION 28 31 00 – FIRE ALARM SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall Design, furnish, and install a complete distributed microprocessor based 24VDC, electrically supervised, intelligent fire alarm system as specified herein. The system shall include, but not be limited to, all control equipment, remote transponders, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. The system shall operate as a non-coded, continuous ringing system which will sound alarm devices until manually silenced, as herein specified.
- C. The system shall be wired as a Class B and style 4 supervised system for all circuits.
- D. System shall have a minimum of two loops and wired to allow expansion of each loop.

1.2 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
 - 1. National electric Code Article 760
 - 2. UL1971 Visual Signaling Appliances
 - 3. ANSI 117.1 Visual Devices
- B. National Fire Protection Association Standards:
 - 1. NFPA 70 National Electrical Code
 - 2. NFPA 72 Protective Signaling Systems
 - 3. NFPA 90A Air Conditioning Systems
 - 4. NFPA 101 Life Safety Code
- C. Local & State Building Codes
- D. Requirements of Local Authorities having Jurisdiction
- E. Underwriters Laboratory Requirements and Listings for use in Fire Protective Signaling Systems.
 - 1. General: The entire system shall be UL listed and named in category UOJZ - Control Units System of the UL Fire Protection Equipment Directory, current edition. The control panel and smoke detectors shall have been tested together and listed as a system
 - 2. UL38 Manual Alarm Systems
 - 3. UL228 Door Holders-Closers
 - 4. UL 268: Smoke Detectors
 - 5. UL268A: Duct Smoke Detectors
 - 6. UL521: Heat Detectors
 - 7. UL 864: Control Panels
 - 8. UL 464: Audible Signaling Appliances
 - 9. UL 1424: Cables
 - 10. UL 1971: Visual Signaling Appliances

- F. Americans with Disabilities Act (ADA)

1.3 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least two years.
- B. The installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
- C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
- D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.
- E. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- F. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years.
- G. Acceptable manufacturers:
1. The Contractor to match existing equipment manufacturer.
 2. The contractor is responsible for making sure the existing Fire Alarm system is up to 2021 Code if not the contractor is responsible in installing or adding the necessary devices to bring the current building up to code.

1.4 ACCEPTABLE MANUFACTURER

- A. Preapproved Manufacturers
1. Contractor to match existing equipment manufacturer.
 - a. NOTIFIER
- B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
- C. All equipment provided shall be available for purchase from at least two authorized distributors within the service area.

1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
1. Control panel wiring and interconnection schematics.

2. Complete point to point wiring diagrams.
 3. Complete floor plan drawings locating all system devices.
 4. Factory data sheets on each piece of equipment proposed.
 5. Detailed system operational description.
 6. Complete system bill of material.
- B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.
- C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices may not be shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein to provide a complete operational system as specified.

1.6 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with **ALL** other trades.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

- A. Alarm Detection
1. When a fire alarm condition is detected via the main fire control panel by any of the system alarm initiating devices, the following functions shall occur:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LEDs to a steady state.
 - b. The 80 character back-lit LCD display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.
 - c. Appropriate status change message(s) shall be transmitted to the system printer if specified to be provided.
 - d. Any remote or local annunciator LEDs associated with the alarm zone shall be illuminated as herein specified.
 - e. The remote signaling or municipal tie connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner).
 - f. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - g. Alarm tones shall sound throughout the facility.
 - h. Visual signals shall be activated throughout the facility.
 - i. De-activate HVAC systems over 2,000 CFM.
 2. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
 3. In addition, remote or local annunciators shall be located where indicated. The

annunciator(s) shall duplicate the control panel alarm status indicators (for selected system zones/points) and in addition, annunciate any system trouble conditions and operate as herein specified.

- B. Alarm Verification:
 - 1. Alarm Verification shall be field programmable for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.
- C. System Trouble Detection:
 - 1. When a trouble condition is detected by the CPU or a system initiating, alarm, or SLC circuit, the following functions shall immediately occur:
 - a. The system trouble LED on the CPU module shall flash, and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LEDs to illuminate steady.
 - b. The 80-character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.
 - c. Appropriate status change/message(s) shall be transmitted to the system printer if specified to be provided.
 - d. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

2.2 ZONING

- A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the architect/engineer.
- B. The system shall utilize remote transponder panels for distributed voice communications, and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent smoke detection and control modules.

2.3 MAIN FIRE ALARM CONTROL PANEL

- A. Main FACP is existing to remain.

2.4 REMOTE TRANSPONDER PANELS

- A. Series XP Remote transponder/control panels shall be distributed remotely throughout the facility as indicated or required on the drawings. Transponders shall be modular in design and provide input/output interface between all field devices/equipment and main system CPU. All functions of the transponder unit(s) shall be FIELD PROGRAMMABLE via the main system CPU and incorporate non-volatile RAM memory. Each unit shall be capable of operating independently in default mode should communication with the main

CPU be disrupted.

- B. The transponder shall include a resident microprocessor-based CPU. The local CPU shall provide each transponder with common status indicators and transponder control. Each CPU module shall include local silence, reset, trouble display, lamp test, and reset capability.
- C. Transponders shall be provided with zone alarm indicating modules as required. Each module shall provide style Y indicating appliance circuits. Each indicating circuit shall be capable of being field programmed as conventional alarm, audio, and/or telephone circuits. Output circuits shall be POWER LIMITED. Each zone shall be equipped with a status and trouble LED indicator. Each alarm indicating circuit/zone shall be field programmable for silenceable or non-silenceable operation.
- D. Transponders shall be provided with auxiliary output/control relay modules as required. Each module shall provide multiple SPDT field programmable output circuits. Designated fan control circuits shall be provided with software assignable manual control switch as herein specified. Each circuit shall be equipped with an individual status LED indicator.
- E. The power supply shall provide all control panel and peripheral power needs with filtered power as well as regulated 24VDC power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet U.L. and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.
- F. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators.

2.5 FIELD DEVICES

- A. Photoelectric Smoke Detector:
 - 1. Intelligent multi criteria acclimating detector shall be provided where required. The intelligent multi criteria Acclimate 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.
 - 2. 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).
 - 3. 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.
 - 4. Detector shall have adjustable sensitivity and give supervisory signal when loaded with dirt.

- B. Intelligent Duct Smoke Detector:
1. Intelligent duct smoke detectors shall be provided where required. The smoke detector housing shall accommodate an intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel. For all duct detectors mounted above ceiling, contractor shall install ceiling mounted LED device to indicate current operating status of detector.
 2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to shutdown air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
- C. Intelligent Thermal Detectors:
1. Intelligent thermal detector shall be provided where required. Thermal detectors shall be intelligent 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. It shall connect via two wires to the fire alarm control panel signaling line circuit.
- D. Addressable Manual Stations:
1. Manual stations shall be provided where required. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required.
 2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type.
- E. Monitor Module:
1. Addressable monitor module or approved equal shall be provided where required. 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 panels SLCs.
- F. Control and Relay Modules
1. Addressable Control Module or approved equal.
 - a. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
 - b. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
 - c. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
 - d. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.
 - e. Addressable Relay Module FRM-1 or approved equal.
 - f. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be Form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

- G. High Intensity Audible Visual Signals:
1. High intensity visual signals shall be installed where required and as may be required by the Americans with Disabilities Act (Public Law 101-336).
 2. High intensity visual alarms shall be xenon strobe type producing a minimum of 100 candela on a 24 VDC limited energy supervised circuit. Alarm devices shall be designed to be flush wall mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 464. Alarm devices shall be integral with audible alarm appliances where appropriate.
 3. Devices requiring programming onto an SLC circuit shall not be acceptable.
 4. Devices shall be red in color
 5. Flash Synchronization: Provide means of synchronizing strobe flashing when more than two strobes in a room or space are visible within the field of view. All such strobes shall flash simultaneously. Provide dedicated power supply or other means to assure strobe synchronization. Example: long corridor with more than two strobes; perimeter of an auditorium or other large room; large common area with more than two strobes.
- H. High Intensity Visual Signals:
1. High intensity visual signals shall be installed as may be required by the Americans with Disabilities Act (Public Law 101-336).
 2. High intensity visual alarms shall be xenon strobe type producing a minimum of 100 candela on a 24 VDC limited energy supervised circuit. Alarm devices shall be designed to be flush wall mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 464. Alarm devices shall be integral with audible alarm appliances where appropriate.
 3. High intensity visual alarms shall be xenon strobe type producing a minimum of 100 candela on a 24 VDC limited energy supervised circuit. Alarm devices shall be designed to be flush wall mounted. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 464. Alarm devices shall be integral with audible alarm appliances where appropriate.
 4. Devices requiring programming onto an SLC circuit shall not be acceptable.
 5. Devices shall be red in color
 6. Flash Synchronization: Provide means of synchronizing strobe flashing when more than two strobes in a room or space are visible within the field of view. All such strobes shall flash simultaneously. Provide dedicated power supply or other means to assure strobe synchronization. Example: long corridor with more than two strobes; perimeter of an auditorium or other large room; large common area with more than two strobes.
- I. Auxiliary AHU Relays:
1. Shall be provided for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. These relays shall be connected hot (fail safe) so that if the cable is broken, disconnected etc., the AHU will automatically shutdown.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wiring:
1. All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
 2. All wire shall be U.L. Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is U.L. Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
 3. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
 4. Minimum wire sizes shall be as follows:
 - a. Initiating Zones: 18 AWG
 - b. Indicating Zones: 14 AWG
 - c. Relay Control Circuits: 18 AWG
 5. Contractor shall ensure that all exterior horn locations will be installed in a weatherproof enclosure and sealed watertight. It is the contractor's responsibility that the conduit and box be installed in a manner that allows the device to be securely installed at all exterior locations and provide waterproofing as required to protect device and wiring.
 6. Fire alarm system dialer shall be installed in accessible location near main fire alarm panel. Dialer shall be installed in its own panel box. Dialer shall be Bosch #D2071/DACT with D4103R Enclosure. Dialer shall be powered from 24vdc source from the Notifier panel.
- B. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
 3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
 4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
 5. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors traversing the respective box as well as the number of terminations required.
 6. All wiring associated with smoke control system shall be installed in conduit per current adopted codes regardless of voltages or ratings.

3.2 TEST AND REPORTS

- A. A state licensed and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- B. The installing contractor shall functionally test each and every device in the entire system

for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and retested.

- C. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.
- D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.
- E. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA Standard 72H. It is mandatory that the installing contractor provide such services and make available these services to the owner upon completion of the project.
- F. As part of the closeout documents, fire alarm contractor will provide owner with AutoCad asbuilt drawings indicating locations of devices, routing of wiring, and panel information. All room numbers indicated on final close out documents and all panel settings shall be listed by actual building room numbers and not by room number indicated on construction documents. CAD files shall be AutoCAD V. 14 or later. Provide the owner with one mylar plot of each drawing and two blue line prints of each drawing. Provide the owner with electronic versions of the as-builts CD's.
- G. Locate next to building FACP and fire alarm annunciator panel
 - 1. A building graphic shall be provided mounted in aluminum-extruded frame with plexi-glass front. Graphic shall locate all fire alarm devices, power supplies, and FACP.
 - 2. State FML-005 certificate shall also be framed and mounted near the fire alarm panel. Fire alarm panel shall have white FM required installation sticker attached to it.
 - 3. Graphic shall include actual room numbers posted as part of the building graphics package, include as part of substantial completion requirement.

3.3 WARRANTY

- A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced, or adjusted during normal working hours at no cost to the owner.
- B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

3.4 FUNCTIONS

- A. Alarm System Automatic Functions:
 - 1. Upon the operation on any sprinkler flow switch, manual pull station, or detector:
 - a. Signal the Fire Alarm Control Panel. Identify the addressable point at the Fire Alarm Control Panel and the remote fire alarm annunciator.
 - b. Sound a distinctive evacuation signal throughout the entire building.

- c. Simultaneously activate all flashing visual alarm assemblies associated with audible indicators.
- d. Shut down all mechanical equipment rated 2000 cfm or greater that circulate air for that floor. This equipment shall include, but shall not be limited to, air handling units, ventilation fans, fan powered boxes, and side pocket boxes. Coordinate with Division 15 Specification Section Air Conditioning Controls as required for passive smoke control.
- e. Close all smoke control dampers. Provide control relay within three (3) feet of each damper or power supply for motor drives or fail-safe dampers. When fail-safe smoke dampers are powered in parallel from a common power circuit then fire alarm relay may be provided to interrupt common power circuit, separate relay not necessary at every such damper. Install supervised fire alarm wiring from relay to fire alarm control panel. Resetting fire alarm system shall include opening smoke control dampers.
- f. Activate and automatic telephone dialer and alarm contact closure for use with approved central station monitoring service. Owner provides NFPA 71 central station connection and maintains that service.
- g. Release all fire and smoke control doors on hold-open devices so that doors may close.
- h. Kitchen:
 - 1) Operation of any kitchen hood fire suppression system shall initiate the alarm building fire alarm control panel. Building fire alarm system shall sound alarm over appropriate notification appliance circuits as required by NFPA 72 sect. 3-8.8.1. Comply with NFPA 96 Standard for Commercial Cooking Operations, sect. 7-3.1.4. Actuation of a dry chemical shall cause building fire alarm per NFPA 17 sect. 3-7.4. Actuation of a wet chemical system shall cause building fire alarm per NFPA 17 sect. 3-2.1.5
- i. Sprinkler System:
 - 1) Operation of any sprinkler system water flow switch shall activate the sprinkler alarm belt.
- j. All alarm signals shall continue sounding and annunciator(s) shall remain lighted until the alarm acknowledged switch is depressed. The alarm signals shall then stop, but the annunciator shall remain lighted until the system is rest.
- k. Acknowledging of any alarm signal shall interfere with the re-activating of the alarm signals upon an alarm from another zone.
- l. Alarm Verification:
 - 1) Provide UL listed alarm verification feature.
 - 2) Alarm verification shall be per addressable, open area smoke detector. Alarm verification shall be field programmable on an individual detector basis. Global or dydte, alarm verification will be unacceptable.
 - 3) If an alarm condition is detected by an automatic smoke detector programmed for ALARM VERIFICATION, an alarm verification sequence shall be initiated. Upon receipt of the initial alarm condition, start the verification sequence as prescribed by UL 864. The system shall rest the alarmed zone/device within the UL prescribed window of 60 seconds maximum. If the alarm condition does not confirm within 60 seconds of the reset signal, the programmed alarm outputs shall be canceled, and the system returned to the normal mode. If the alarm condition re-occurs within the designated verification cycle or a non-verified device or zone activates, the programmed events listed above

- 4) shall immediately occur for the confirmed alarm condition.
Alarm verification shall not be used for any spaces programmed to required two smoke detectors to initiate an alarm response (ex. elevator lobbies), per NFPA 72-1993 Sect. 3-8.2.5.

3.5 WALK TEST

- A. Notify Owner, Architect and Engineer when system is 100 percent operational. Schedule walk-through of the entire facility and verify that each initiating and each indicating device is operating properly.
- B. Provide report at conclusion of walk through certifying all fire alarm devices are working.
- C. Walk test shall include a representative from owner maintenance department.
- D. Walk test to show in a printed report all AHU shutdown, Sprinkler Tamper Report, Sprinkler Flow switch, strobes/horns, and smoke detectors. Report shall list all devices by approximate location to rooms, and device number. All duct detectors shall include flow differential at the detector as measured by a manometer. Manometer reading shall match manufacturer's specification for duct detector used.

3.6 SOFTWARE

- A. Installer shall provide a backup copy of the installed program database (usb drive and CD) upon completion of the project.

END OF SECTION

SECTION 32 13 14 – PEDESTRIAN CONCRETE PAVING

PART 1 - GENERAL:

1.1 SUMMARY:

- A. Section Includes:
1. Concrete bands, sidewalks, and pavements.
 2. Sawcut jointing patterns
 3. Expansion joints

1.2 REFERENCES:

- A. American Concrete Institute (ACI)
1. 211.1-77 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 2. 214-77 Recommended Practice for Evaluation of Compressive Test Results of Field Concrete
 3. 305-73 Recommended Practice for Hot Weather Concreting.
 4. 306-66 Recommended Practice for Cold Weather Concreting.
 5. 347-68 Recommended Practice for Concrete Formwork.
- B. American Society for Testing and Materials (ASTM)
1. A-82-76 Cold Drawn Steel Wire for Concrete Reinforcement.
 2. A615-78 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. C33-78 Concrete Aggregates.
 4. C94-78 Ready Mixed Concrete.
 5. C150-78a Portland Cement.
 6. C260-77 Air Entraining Admixtures.
 7. C330-77 Lightweight Aggregates for Structural Concrete.
 8. C494-79 Chemical Admixtures for Concrete.
 9. D1751-73 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and resilient Bitumens Type).

1.3 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Laboratory Services
 - 1. Perform all required tests and coordinate all efforts with the designated testing laboratory.
 - 2. Cooperate with testing laboratories to permit proper testing and inspection procedures.
- D. Source Limitations:
 - 1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.4 SUBMITTALS:

- A. Forms: Submit Data with complete illustrations and/or descriptions for the following:
 - 1. Inserts, anchors, sleeves and other embedded items.
 - 2. Expansion joint fillers.
 - 3. Vapor Barrier
- B. Cast-In-Place Concrete:
 - 1. Mix Designs:
 - a. Mix Designs for each type of concrete
 - 2. If mix designs are based upon field experience with materials to be used, submit substantiating data at time of submitting mix designs. If suitable field performance data cannot be provided, submit laboratory confirmatory test results upon each proposed mix design. Use only mix designs accepted in writing by Owner's representative.
 - 3. Product Data: Submit to Owner's representative for each mix design:
 - a. Certified mill reports on cements.
 - b. Certified sieve analysis on aggregates.
 - c. Cement manufacturer's name and brand name.
 - d. Manufacturer's name and brand names of materials listed as products of more than one approved manufacturer.
 - 4. Truck Delivery Tickets: Include on each ticket:
 - a. Certification required by ASTM C94.
 - b. Type and brand name of cement.

- c. Amount of cement, in pounds.
 - d. Total amount of water, in gallons.
 - e. Maximum size aggregate.
- C. Shop Drawings: Submit six (6) copies of sub-slab shop drawings indicating expansion joint layout. Layout shall be submitted in conjunction with granite shop drawings. Expansion joints shall align accordingly.
- D. Samples: Approved samples shall be the standards for finishes in concrete work.
 - 1. Flatwork: Provide 5' x 5' samples of each mix and finish specified until approved by Landscape Architect. Samples shall be representative of the finish concrete and shall include, but not limited to; expansion joints, control joints, saw cut joints, patterning, finish, and color.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Store new and reusable form lumber and form plywood under heavy waterproof coverings or where well protected from inclement weather.
- B. Stack oiled form plywood on sticking to permit proper ventilation between uses.
- C. Handle and store metal forms in such manner as to prevent damage by denting, warping, twisting and rusting.
- D. Deliver reinforcing to site in easily handled bundles with identification tags securely wired into place. Store reinforcing to prevent damage and protect from corrosion and deformation.

1.6 PROJECT CONDITIONS:

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.7 GENERAL REQUIREMENTS:

- A. All concrete work shall be true to line and grade as indicated on the drawings. The Contractor shall be responsible for proper drainage, without birdbaths, on all concrete paving surfaces. Any discrepancies or omissions on drawings, or conditions on the site, which prevent this Contractor from providing proper drainage shall be brought to the attention of the Owner's representative in writing for correction or relief before work proceeds.
- B. Surface Tolerance: Finished paving surfaces shall not vary more than 1/4" inch measured with a 10' metal straight edge, except at grade changes. No birdbaths or other surface irregularities will be permitted. Correct irregularities as directed.

1.8 ENVIRONMENTAL CONDITIONS:

- A. Observe provisions of ACI-305 when ambient temperature is 90 degrees F. and greater.
- B. Observe provisions of ACI-306 when ambient temperature is 40 degrees F. and less.

PART 2 – PRODUCTS

2.1 PORTLAND CEMENT:

- A. Shall conform to current requirements of ASTM Designation C150, Type I or II cement.

2.2 COARSE AGGREGATE:

- A. ASTM C - 33 ; 1"-3/8" limestone.

2.3 FINE AGGREGATE:

- A. Sand shall be clean, hard and durable with uncoated grains free from injurious amounts of silt, loam clay or other deleterious matter, conforming to ASTM C33, grade in size from coarse to fine with 95-100% by weight passing a #4 sieve, 45-70% passing a #16 sieve, 15-30% passing a #50 sieve and 3-8% passing a #100 sieve

2.4 WATER:

- A. Provide clean, potable, concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials or other deleterious matter.

2.5 AIR ENTRAINMENT:

- A. Air-entraining admixture shall conform to ASTM C260.

2.6 WATER REDUCING AGENTS, RETARDERS, ACCELERATORS:

- A. ASTM C494: Water reducing, normal setting admixture: Type A. Water reducing, retarding admixture: Type D.

2.7 VAPOR BARRIERS:

- A. Vapor Barrier (Under all slabs) shall comply with ASTM E1745 Class A, maximum WVTR 0.008, minimum 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.8 REINFORCING:

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed billet-steel, clean and free from rust, scale, or coating that will reduce bond.
- B. Welded Wire Fabric: Not acceptable.
- C. Cold Drawn Steel Wire: ASTM A82.
- D. Bar Chairs: 16 gauge galvanized steel wire, with 3" x 3" base, or solid plastic of proper sizes and design to properly support and position reinforcing steel.

2.9 METAL DOWELS:

- A. ASTM A36.

2.10 EXPANSION JOINT MATERIALS:

- A. Premolded Joint Filler: To be "Sonoflex-F", a closed cell plastic joint filler, as manufactured by Sonneborn-Contech, Building Products Division, Contech, Incorporated, or approved equal.
- B. Joint Sealant: To be "Sonolastic Sealant Two-Part" as manufactured by Sonneborn-Contech, Building Products Division, Contech, Incorporated, or approved equal. Color shall match adjacent concrete work.
- C. 1/2" thick Asphalt saturated fiber expansion joint filler: Preformed with dowels as provided by Contractors Paving Supply in Stafford, Texas or approved equal.
- D. Metal Screed Key joints: As indicated on the drawings as provided by Sheplers, Houston, Texas or approved equal
- E. All expansion joint material shall be 1/2" thickness.

2.11 CURING MEMBRANE:

- A. Submit a manufacturer of a spray on curing membrane to be used on all exposed concrete surfaces for approval. Conform to ASTM 309.
- B. Select a fugitive color for above

- C. In lieu of above, submit a plan for slow curing all concrete for approval by the Owner's Representative

2.12 WOOD FORMS:

- A. Form Lumber: Number 2 Southern pine or Number 2 Douglas Fir-Larch, surfaced four sides; true and straight members free from cupping, warping, loose knots, excessive checking and other structural defects.
- B. Moldings and Chamfer Strips: "C-Select" or "Finish" Southern pine, straight, sound, and free of knots and other defects.
- C. Used form materials may be reused provided that they are thoroughly cleaned and acceptable finishes can be produced.

2.13 METAL FORMS:

- A. Heavy gauge steel of sufficient strength to prevent undue deflection, properly braced. Use only materials with smooth and regular contact surfaces, free from dents and irregularities that affect regularity and finish surface of concrete.

PART 3 - EXECUTION

3.1 DESIGN OF MIXES AND PROPORTIONING:

- A. Proportioning and mixing of cement, aggregate, admixture and water to attain required plasticity and strength shall be in accordance with ACI-304.
- B. Concrete Mixture: Concrete mixtures shall be designed by an approved commercial testing laboratory at no expense to the Owner, using approved materials furnished by the Contractor to obtain a minimum compressive strength of 4,000 pounds per square inch at 28 days of age and an air content by volume of 6% plus or minus 1.0 percent. The slump of the concrete shall be not more than 4".

3.2 SETTING FORMWORK:

- A. Forms shall be constructed accurately to dimensions, plumb and true to line and grade. Forms shall be substantial, mortar tight and braced, and tied so as to maintain position and shape during placing of reinforcing and concrete. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will not be acceptable.
- B. Do not re-use forms for exposed concrete surfaces. Coat all wood forms with form oil or release agent before pouring. Release agent shall be required on form surfaces where concrete is exposed to view in finished work.

- C. Forms shall be constructed and assembled in such a manner that construction joints shall occur at approved locations.
- D. Care shall be taken in all details of forming, setting, reinforcing, mixing and placing all concrete exposed in finish work to obtain smooth, even surfaces of dense concrete, and clean sharp inside and outside corners, except where tooled corners are indicated. Use of form oil will be required to prevent concrete from bonding to form.
- E. Forms shall be carefully observed and checked for alignment and level as the work proceeds. All needed adjustment or additional bracing shall be done promptly.
- F. Forms shall remain in place long enough to allow concrete to set properly and the Contractor shall assume all responsibility for removing same.

3.3 VAPOR BARRIER

- A. Plastic Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturers recommended tape.
- B. Granular Course: Cover vapor barrier with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 - 1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.4 PLACING REINFORCEMENT:

- A. Place all reinforcement as shown on drawings. Place accurately and securely fasten and support reinforcement to prevent displacement before or during pouring. Support bars and/or wire mesh with suitable reinforcing chairs.
- B. Do not heat bars for bending or straightening. Do not tack weld bars.
- C. Clean, bend and place reinforcement in accordance with current requirements of the ACI Manual of Concrete Practice.
- D. Reinforcement Splices:
 - 1. Reinforcing bars - 24 bar diameter minimum, except as otherwise noted.

3.5 PLACING CONCRETE:

- A. Concrete shall be deposited so as to require as little rehandling as practicable. All placing equipment shall be clean and free from hardened concrete.

- B. Placing shall be continuous between transverse joints or in individual sections of the work. Spade concrete thoroughly along forms and expansion joints, and work carefully into corners and around reinforcement. Tamp and screed to a dense mass.
- C. Convey concrete from mixer to place of final deposit in one continuous operation and until entire unit being placed is complete. Maintain plasticity of concrete to flow readily into formwork and embed reinforcement without segregation of aggregates.
- D. Use chutes of uniform shape and slope controlling concrete fall to not more than 3'.
- E. Place no partially hardened, contaminated or retamped concrete.

3.9 FINISHES: (Ref. 03 35 10.2, 03 35 10.1, 03 35 19, for finishes not shown)

- A. Medium broom Finish: Shall be obtained by drawing a medium bristled broom across a floated finish. Direction of brooming to be perpendicular to direction of walk or as otherwise shown on drawings.

3.10 JOINTS: (Reference Drawings for Locations of each type joint.)

- A. Score Joints: Score joints shall be formed in the fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained. All joints shall be struck before and after brooming/troweling. Contractor to fabricate special score joint tools as shown on plans.
- B. Expansion Joints and Edging: Expansion joints shall be formed provided at the location and intervals as shown on the plans, and at all locations where concrete paving abuts buildings, curbs, or other structures. Approved joint material shall be placed with top edge 1/2" below the paved surface, and shall be securely held in place to prevent movement. Joint and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression. All edges shall be struck before and after brooming. After the curing period, expansion joints shall be carefully cleaned and filled with approved joint compound to 1/4" below paved surface in such a manner as to avoid spilling on paved surfaces or overflow from joint.
- C. Saw Cut Joints: Sawing of joints shall be sawn as soon as the concrete will support the weight of the saw and the operator without marking or damaging the concrete. The saw cut shall be 1/4" wide by 1/4 the depth of the slab and shall have chamfered edges as detailed by using the Soff-Cut Ultra Early Entry system with ProEdge beveled blades or approved equal.

3.11 CURING AND PROTECTION AND PATCHING:

- A. Protect concrete against frost, rapid drying and damage by rain and keep moist for at least 7 days after placing. Protect during this period by wet burlap, canvas covering (ASTM 171) or liquid curing compound. Curing by the use of saturated burlap. Sprinkler or membrane where approved shall commence immediately upon completion of finishing. Secure Owner's approval of proposed method. During this period, maintain concrete

above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days. Concrete from which forms are removed within 7 days after pouring shall be sprayed during the curing period as frequently as drying conditions may require. Concrete covering shall be a type that will not stain or discolor finished concrete surfaces. Cure concrete in accordance with requirements of the current ACI Manual of Concrete Practice. Apply a spray on curing compound in accordance with manufacturer's recommendation and as specified herein where allowed.

B. Protect all concrete work against injury and defacement to walls and steps during subsequent construction operations, and until acceptance by the Owner.

C. PATCHING:

1. The use of "pavecrete" or other surfacing material will not be permitted.
2. Minor chips (2" X 2") or less which occasionally occur as a result of related construction activities may be patched using approved material.
3. The color and finish of all patches must exactly duplicate the surrounding pavement.
4. Remove any stains or spills on finished concrete work immediately.
5. Upon completion of the work clean all areas.
6. Remove any chalk lines used for sawcut joint layout

END OF SECTION 32 13 14

SECTION 32 15 40 - GRAVEL PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Decomposed granite.
 - 2. Stabilizer binder
- B. Related Sections:
 - 1. Section 31 22 00: Grading.
- C. Reference Standards:
 - 1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

1.3 SUBMITTALS

- A. Comply with Section 01 Shop Drawings: Submit plan layout of all gravel walkway surfacing areas and detail drawings showing the various components of the surfacing system, including subbase and edging.
- B. Product Data - Manufacturer's literature completely describing all components of the decomposed granite surfacing system, including:
 - 1. Quarry of origin
 - 2. Preparation instructions and recommendations.
 - 3. Stabilizer binder brand information and manufacturer certification
 - 4. Installation methods and application procedures.
 - 5. Maintenance manual
- C. Samples for Verification - Submit samples of each of the following:
 - 1. Two-pound sample of each type and color of gravel surfacing material.
 - 2. Edging material, each type not less than 12 inches long.
- D. Certification:
 - 1. Manufacturer and Installer Qualifications.

1.4 QUALITY ASSURANCE

- A. Comply with Section 01 40 00: Quality Requirements.
- B. Manufacturer: Company specializing in manufacturing Work of this Section with minimum 10 years documented experience.

- C. Single Source Responsibility: Obtain each type of decomposed granite surfacing from single manufacturer.
- D. Mock Up - Provide a mock-up for evaluation of surface preparation, installation techniques and quality of application:
 - 1. Install a 4-feet x 4-feet minimum of gravel surfacing, including stabilizer binder, subbase course and edging, at location approved by Landscape Architect.
 - 2. Do not proceed with remaining work until installation of decomposed granite surfacing is approved by Landscape Architect.
 - 3. Approved mock-up may remain as part of completed Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 60 00: Product Requirements.
- B. Bagged Materials: Accept delivery of materials only in unopened and undamaged containers bearing the brand name and manufacturer's identification.
- C. Bulk Materials - Each load of gravel surfacing material arriving at the job site in bulk shall be accompanied by a delivery ticket containing the following minimum information:
 - 1. Quarry of origin.
 - 2. Amount, weight and type of material.
 - 3. Brand name and manufacturer's identification.
 - 4. Protect gravel surfacing materials from contamination until ready for installation. Store under cover.

1.6 PROJECT CONDITIONS

- A. Surfaces to receive decomposed granite surfacing shall be frost free and free of oil or any other foreign matter, which may impair the proper installation of the surfacing system.
- B. Do not install gravel surfacing when subbase course is muddy or saturated with standing water.
- C. Perform work in dry weather when subgrade is sufficiently stable to be properly compacted.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

Manufacturers:

- A. Collier Materials
 - 1. Collier Material, Inc.: (830) 693-2228 201 Co Rd 121, Marble Falls, TX 78654
- B. Kafka Granite
 - 1. Katka Granite LLC: 715-814-1268 550 East Hwy WI-153 Mosinee, WI 54455
- C. The Ground-Up
 - 1. The Ground-Up: (281) 970-003 Scott Bort (346) 314-9487 9945 Windfern Rd. Houston, TX 77064

- D. Alamo Stone
1. Alamo Stone: (281) 240-4600 13020 S Kirkwood Rd, Stafford, TX.
Sales@alamostone.com
- E. Stabilizer Binders
1. Stabilizer Solutions: (800) 336-2468 33 South 28th St Phoenix, AZ
2. Organic-Lock: (866) 636-8476 Envirobond Products 6191-2100 Bloor St W. Toronto, Canada
3. Romex D7000 Rock Dust Stabilizer
- F. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00: Substitution Procedures and Form.

2.2 GRAVEL SURFACING MATERIALS

- A. Recycled Content of Decomposed Granite or Crushed Stone Surfacing Materials: **10%**
- B. Decomposed Granite and Crushed Stone Aggregate: Provide high quality materials consisting of sound, angular, durable stone particles, free from clay lumps, organic materials, frozen materials, or other deleterious substances.
- C. Gradation - Manufacturer's standard mix of well-graded materials in accordance with ASTM C136. Blends of coarse sand and rock dust are not acceptable:

Standard Pathway Optimal Gradation		
Sieve	Sieve Size (mm)	Percent Passing
3/8"	9.51	100%
#4	4.76	80-100%
#8	2.36	65-90%
#16	1.18	40-60%
#30	0.6	25-55%
#50	0.3	15-35%
#100	0.149	10-20%
#200	0.074	7-15%

2.3 SUBBASE COURSE MATERIALS

1. 3/4" minus aggregate base class 2.

2.4 ACCESSORIES

- A. Stabilizer Binder and decomposed granite shall always be blended. Mix uniformly and consistently throughout decomposed granite, per manufacturer's specifications.
- B. Water: Clean and potable, free from contaminants that would be deleterious to the decomposed granite surfacing.
- C. Steel Edging: Reference contract drawings for location, sizing, and manufacturer. Comply with Section 32 93 00.

- D. Stakes: Reference contract drawings specified product and install per manufacturer specification.
- E. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Application of the herbicide shall pose no short- or long-term health threats to the installer or the general public.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Notify Landscape Architect of unsatisfactory preparation before proceeding.
- B. Correct conditions detrimental to timely and proper completion of Work.
- C. Do not proceed until unsatisfactory conditions are corrected.
- D. Lay out work prior to the commencement of installation.

3.2 PREPARATION

- A. Excavation: Excavate to depth required so edges of decomposed granite surfacing will match adjacent grades and have a maximum cross-slope of 2 percent. Ensure edges and bottom of excavation are in a smooth and even line.
- B. Subgrade Preparation: Plow, harrow and mix the entire surface of the in-place subgrade to a depth of at least 6-inches. After the material has been thoroughly mixed, the subgrade shall be brought to line and grade and compacted to 95% of the maximum laboratory dry density as determined by the Standard Proctor test.
- C. Herbicide: Apply herbicide per manufacturer's written instructions. Limit the application to the area to receive decomposed granite surfacing.
- D. Subbase Course Preparation: Place the subbase coarse aggregate free from ridges, depressions, or hollows. Rake and compact to 95% Standard Proctor Density.

3.3 INSTALLATION

- A. Steel Edging: Install edging flush with the top of the decomposed granite surfacing. Provide sufficient stakes to secure edging in place during and after decomposed granite surfacing material installation.
- B. Subgrade - Proof-roll the subgrade with heavy pneumatic-tired equipment to locate unstable areas and to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades:
 - 1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect, and replace with compacted backfill or fill as directed.
 - 2. The surface of the completed subgrade shall be bladed to a smooth and uniform texture.
 - 3. The finished subgrade shall be uniform and free from deleterious debris such as

organic materials, nails, stones and loose soil.

- C. Subbase: Install aggregate subbase to a compacted depth of 4 inches minimum for pedestrian traffic, and 8 to 12-inches minimum for vehicular traffic in accordance with manufacturer's recommendations. Install the subbase in multiple 3 to 4-inch lifts, and compact to a minimum 95% density.
- D. Compaction - Compact each lift of the subgrade, subbase and final finish decomposed granite surfacing materials with a one to three-ton roller or compactor. In small areas that are difficult to access with compaction equipment, hand tamping may be performed with multiple passes to achieve the required density:
 - 1. Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

3.4 INSTALLATION OF GRAVEL SURFACING

- A. Thoroughly mix stabilizer binder and gravel proportionally to manufacturer's specifications.
- B. Spread gravel surfacing material in 3 to 4-inch lifts. Spread the pathway mix evenly and smoothly before compacting. Allow for 20-25% compaction. Screed if possible.
- C. Wet the mix to ensure water has penetrated the full depth of the gravel surfacing material, and roll each lift to form a uniform, smooth surface with a cross slope of 2% maximum. Compact each lift to a minimum 95% density.
- D. Grade and smooth to the required elevation; compact final lift with 1-3 ton drum roller or compactor.
- E. Minimum Compacted Thickness:
 - 1. Pedestrian Paths: 4-inches.
 - 2. Vehicular Drives and Roadways: 6-inches.
- F. Surface shall follow grades per plans. Remove crown, allow 1-2% cross pitch.
- G. Completed surface shall be of consistent quality and shall not have depressions or humps greater than 1/4-inch in 10-feet.

3.5 INSTALLATION TOLERANCES

- A. Gravel Surfacing Thickness - Allow for 20-25% compaction:
 - 1. Subbase Course: Plus or minus 1/2-inch.
 - 2. Surface Course: Plus 1/4-inch, no minus.
- B. Decomposed Granite Surfacing Smoothness: Produce a surface smoothness within 1/4-inch tolerance when measured with a 10-foot straightedge.
- C. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowed variance from template is 1/4-inch

3.6 CLEAN-UP AND PROTECTION

- A. Thoroughly clean all areas where work has occurred. Remove from site excess material,

debris and rubbish.

- B. Take all precautions necessary to protect completed work until Substantial Completion of project.

END OF SECTION 32 15 40

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Posts, rails, and frames.
 - 2. Wire fabric.
 - 3. Concrete.
 - 4. Accessories.
- B. Related Sections:

1.3 PRICE AND PAYMENT PROCEDURES

1.4 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
- C. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.
- D. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. Refer to CLFMI CLF-SFR0111 for planning and design recommendations.
- D. Samples: Submit two samples of fence fabric, slat infill, ____ inch (____ mm) by ____ inch (____ mm) in size illustrating construction and colored finish.
- E. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and _____.
- F. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines _____.
- G. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, barbed wire, fittings and accessories, gates, and workmanship.

1.6 QUALITY ASSURANCE

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for _____.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience

manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Chain Link Fences and Gates:

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 COMPONENTS

A. Top and Brace Rail: 1.66 inch (42 mm) diameter, plain end, sleeve coupled.

B. Tie Wire: Aluminum alloy steel wire.

2.3 MATERIALS

A. Posts, Rails, and Frames: _____:

B. Wire Fabric: _____:

C. Concrete: _____:

2.4 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

2.5 FINISHES

A. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

B. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris and _____.

B. Preinstallation Testing: Test areas for ledge and _____.

3.2 PREPARATION

A. Removal: Obstructions or debris.

B. Ground Preparation:

1. Grading _____.

3.3 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

D. Do not stretch fabric until concrete foundation has cured 28 days.

E. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.

F. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.

G. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

H. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

I. Peen all bolts upon installation.

J. Perform three random field inspections confirming proper installation.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Position: 1 inch (25 mm).
- C. Do not infringe on adjacent property lines.

3.5 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- E. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.6 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.7 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures, for closeout submittals.

END OF SECTION 32 31 13

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SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
- B. Related Requirements:
 - 1. Section 31 23 16 - Excavation.

1.3 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- D. ACI 305R - Guide to Hot Weather Concreting; September 2020.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.
- F. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- G. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- I. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- K. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- D. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and _____.
- E. Manufacturer's Qualification Statement.

- F. Installer's Qualification Statement.
- G. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines _____.
- H. Field Inspection Records: Provide installation inspection records that include post settings, framework, fittings and accessories, gates, and workmanship.
- I. Manufacturer's Warranty.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for _____.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:
 - (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
 - (b) ACI 301, "Specifications for Structural Concrete."
 - (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
 - (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
 - (e) ACI 305R, "Guide to Hot Weather Concreting."
 - (f) ACI 306R, "Guide to Cold Weather Concreting."

(g) ACI 318, "Building Code Requirements for Structural Concrete and Commentary."

4. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 1. Total Coating Thickness: 2 mils (0.058 mm), minimum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. When cutting rails immediately seal the exposed surfaces by:
 1. Removing metal shavings from cut area.
 2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
 3. Apply two coats of custom finish spray paint matching fence color.
 4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.
- D. Excavate post holes in accordance with Section 31 23 16.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6.3 mm).
- B. Maximum Offset From Indicated Position: 1 inch (25.4 mm).
- C. Minimum Distance from Property Line: 6 inches (152 mm).

3.5 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 1. Hole diameter.
 2. Hole depth.
 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.

- E. Workmanship: Verify neat installation free of defects.

3.6 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.

3.7 CLOSEOUT ACTIVITIES

3.8 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 31 19

SECTION 32 33 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bollards
 - 2. Raised Planters
 - 3. Benches.
- B. Related Requirements:
 - 1. Section 03 30 10 "Cast-in-Place Concrete" for installing pipe sleeves cast, installing anchor bolts cast in concrete footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish, not less than 6-inch- long linear components and 4-inch- square sheet components.
- E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Trash Receptacle Inner Containers: Two full-size units for each size indicated.

PART 2 - PRODUCTS

2.1 SITE FURNISHINGS

- A. Products: Refer to the Drawings **Sheet L2.00 – Materials Schedule**.

2.2 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.3 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.5 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with

coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.6 IRON FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run directional finishes with long dimension of each piece.
 - 2. Directional Satin Finish: No 4.
 - 3. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD

of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 32 33 00

SECTION 32 33 13 - SITE BICYCLE RACKS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior bicycle racks.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Mounting surface for bicycle racks.
 - 2. Section 05 50 00 - Metal Fabrications: Custom metal outdoor furnishings.
 - 3. Section 32 13 13 - Concrete Paving: Mounting surface for bicycle racks.

1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2024.
- D. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2025.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.
- I. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- J. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.
- K. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- M. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- N. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- O. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- P. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- R. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Exterior Bicycle Racks:
 - a. American Bicycle Security Company: www.ameribike.com.
 - b. BRP by Bison, Inc: www.brpbysison.com.
 - c. Columbia Cascade Company: www.timberform.com.
 - d. Highland Products Group, LLC: www.indoorbikeracks.net.
 - e. Huntco Supply, LLC: www.huntco.com.
 - f. MADRAX, a brand of Graber Manufacturing, Inc: www.madrax.com.
 - g. Neenah Foundry, a division of Neenah Enterprises, Inc: www.nfco.com.
 - h. Reliance Foundry Co. Ltd: www.reliance-foundry.com.
 - i. Saris Infrastructure: www.sarisinfrastructure.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: AWS D1.2/D1.2M.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 BICYCLE RACKS

- A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 - 1. Capacity: Seven bicycles.
 - 2. Accessories: Surface flange cover.
- B. Materials:
 - 1. Precast Concrete: Refer to Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive bicycle racks.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- C. Do not begin installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install level, plumb, square, and correctly located as indicated on drawings.
- C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch (13 mm) by 4 inch (101 mm) anchor bolts through flange holes.
- D. Freestanding Installation: Place in location indicated on drawings.

3.4 CLEANING

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 33 13

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SECTION 32 91 00 - SOIL PREPARATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Furnish and installation the planting mediums.
 - 2. Testing and/or certifications of components.
 - 3. Mixing of planting mediums.
 - 4. Transporting mediums as required.
 - 5. Weed Control
- B. Related Sections:
 - 1. Finish Grading - Section 31 22 15
 - 2. Sprinkler Irrigation System - Section 32 84 00
 - 3. Lawns and Grasses - Section 32 92 00
 - 4. Planting - Section 32 93 00

1.2 QUALITY ASSURANCE

- A. Certificates of Inspection: Certificates of inspection required for transportation shall accompany invoice for each shipment of materials. File copies of certificates with Landscape Architect after acceptance of material.
- B. Testing:
 - 1. Soil Analysis Requirement:
 - a. Prior to planting, the Contractor shall have the existing on-site soil tested by an approved laboratory to determine the necessary amendments required to meet soil suitability standards as indicated in the laboratory's recommendations.
 - b. Chemical and Physical analysis
 - 2. Approved Testing Laboratories:
 - Texas A&M Agrilife Extension Service Soil Testing
2476 TAMU
College Station, Texas 77843
(979) 321 5960
 - A&L Plains Agricultural Laboratories, Inc.
302 34th Street
Lubbock, Texas 79404
(806) 763-4278
 - Soil and Plant Laboratory, Incorporated
Post Office Box 153
Santa Clara, California 95052
(408) 243-0330
 - 3. Biological:
 - Soil Food Web, Inc.
1128 NE 2nd Street Suite 120

Corvallis, Oregon 97330
www.soilfoodweb.com
(541) 752-5066

4. If herbicide contamination is suspected, then a radish/rye-grass growth trial must be performed.
5. For delivered material, test one sample for each 100 cubic yards of bulk material delivered to the site.
6. Testing will be at the expense of Contractor.
7. Deviations greater than plus or minus twenty (20%) percent from control data may be grounds for rejection. Non-conforming materials shall not be used.
8. Materials which do not conform to standards specified herein shall be removed from the site.

1.3 SUBMITTALS:

- A. Furnish copies of manufacturers' literature, certifications, sources, samples, or laboratory analytical data for the following items:
 1. Existing soil testing data
 2. Organic Amendments and Fertilizers
 3. Planting Soil Mix: 1-quart volume of planting soil bed mix required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 4. Sand.
 5. Compost: 1-quart volume of compost required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 6. Herbicides: Product information
 7. Pre-Emergent Herbicides: Product information

PART 2 PRODUCTS

2.1 PLANTING SOIL:

- A. Grading:

Sieve Size (per ASTM D422)	Percent Passing Sieve
25.4 mm (1")	95-100
9.51 mm (3/8")	85-100
53 Micron (270 mesh)	10- 30

- B. Chemistry - Suitability Considerations:
 1. Salinity: Saturation Extract Conductivity E_{Ce} less than 2.2 mmhos/cm @ 25 degrees C.) mmhos/cm.
 2. Sodium: Sodium Absorption Ratio (SAR) less than 9.0.

3. Boron: Saturation Extract Concentration less than 2.0 ppm.
4. Reaction: pH of Saturated Paste: 6 - 7.5.
- C. Pests:
The population of any single species of plant pathogenic nematode: Fewer than 500 per pint of soil (confirm by biological testing).
- D. Fertility Considerations:
Soil to contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium, and magnesium to support normal plant growth. In the event of nutrient inadequacies, provisions shall be made to add required materials to overcome inadequacies prior to planting.
- E. Source of above shall be approved and conformity of material shall be laboratory verified for each 100 cubic yards of material delivered to the site.
- F. Percentage of Organic Matter: Min. 4-8% by dry weight
- G. Physical Soil Parameters
 1. Clay: 5-25%
 2. Silt: 25-50%
 3. Sand: 25-50%

2.2 ON SITE MATERIAL:

- A. Specified backfill mixes shall consist of on site material conforming to the requirements determined to be appropriate by the existing site soil testing.
- B. Test on site topsoil from designated stockpile area or borrow site for conformity to this specification. Submit test to Landscape Architect for verification and alteration of components.

2.3 WOOD RESIDUALS:

- A. Source:
Shall be non-composted wood residuals that have not been chemically treated or dyed. Aged min. 1 year with appropriate C:N Ratio or less than 50:1 at 10-20% of total mix.

- B. Physical Properties - Grading:

U.S. Sieve Dry Weight Percent Passing

3/8"	100
1/4"	90 - 100
No. 8	70 - 100
No. 35	0 - 30

- C. Organic Content by Ash Analysis:

90 - 100 Percent Dry Weight

- D. Chemistry Range:

1. Saturation Extract Conductivity (ECc) Nil - 3.5

2. Reaction (pH) 6-8

E. Salinity: Maximum saturation extract conductivity 3.5 millimhos per cm @ 25 degrees centigrade.

2.4 SAND:

A. Physical Properties - Grading:

U.S. Sieve Percent Passing

No. 4	100
No. 10	95 - 100
No. 18	90 - 100
No. 35	65 - 100
No. 60	0 - 50
No. 140	0 - 20
No. 270	0 - 7

B. Chemistry: Range:

1. Saturation Extract Conductivity (ECc) Nil - 3.0
2. Sodium Absorption Ratio (SAR) Nil - 6.0
3. Boron - ppm in saturation extract solution Nil - 3.0
4. Reaction (pH) 6.0 - 7.5
5. Available calcium - sodium acetate extractable - ppm dry weight Nil - 4000
6. Soluble-Salt Content: 1 to 2dS/m measured by electrical conductivity

C. Coarse Sand – concrete sand

2.5 COMPOST:

Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.

A. Chemical components:

1. pH - 6.0-8.0
2. Nitrogen – 30 ppm or higher
3. Phosphorus – 150 ppm or higher
4. Potassium – 400 ppm or higher
5. Calcium – 3000 ppm or higher
6. Magnesium – 250 ppm or higher
7. Salinity – 2500 ppm or lower
8. Zinc – 6 ppm or higher
9. Iron – 25 ppm or higher
10. Manganese – 16 ppm or higher
11. Copper – 0.4-2.0 ppm
12. Sodium – 1000 ppm or less
13. Sulfur – 25 ppm or higher

14. Boron – 2 ppm or higher

- B. Biological components:
1. Bacteria – minimum of 150 micrograms per gram of soil of total bacteria
 2. Fungus – minimum of 150 micrograms per gram of soil of total fungus
 3. Protozoa
 - a. flagellates – 10,000 units per gram of soil
 - b. amoebae – 10,000 units per gram of soil
 - c. ciliates – 20 units per gram of soil

2.6 CHEMICAL ADDITIVES (OR EQUIVELANTS):

The following soil components listed may have a particular application specified within this Section. Some of the soil components included shall be applied at rates determined by the soil tests called for under other paragraphs of this Section or as a result of soil tests. Some of the components may not be required by the soils tests. All additives shall be the slow release type.

- A. Ground Limestone: Agricultural limestone containing not less than eighty five (85%) percent of total carbonates, ground to such fineness that fifty (50%) percent will pass a 100 mesh sieve and ninety (90%) percent will pass a 20 mesh sieve. Used to correct pH.
- B. Dolomite Lime: Agricultural grade mineral soil conditioner containing thirty five (35%) percent minimum magnesium carbonate and forty nine (49%) percent minimum calcium carbonate, 100 percent passing #65 sieve. Kaiser Dolomite 65 AG or approved equal.
- C. Gypsum: Agricultural grade product containing eighty (80%) percent minimum calcium sulphate.
- D. Iron Sulphate (Ferric or Ferrous): Shall contain thirty (30%) to thirty five (35%) percent iron, thirty five (35%) to forty (40%) percent sulphur and be supplied by a commercial fertilizer supplier.
- E. Sulphate of Potash: Agricultural grade containing fifty (50%) percent to fifty three (53%) percent of water soluble potash.
- F. Single Superphosphate: Commercial product containing nineteen (19%) to twenty (20%) percent available phosphoric acid.
- G. Ammonium Sulphate: Commercial product containing approximately twenty one (21%) percent ammonia.
- H. Calcium Nitrate: Agricultural grade containing fifteen and one-half (15 1/2%) percent Nitrogen.
- I. I.B.D.U. (Iso Butylidene Diurea): Commercial product containing thirty one (31%) percent Nitrogen.
- J. Soil Sulphur: Agricultural grade sulphur containing a minimum of ninety six (96%) percent sulphur.
- K. Iron Chelate Micronutrient: Sequestrene - 330 Fe; 0-0-0; ten (10%) percent Fe; Ciba-Geigy Company.

2.7 FERTILIZERS AND NUTRIENT AMENDMENTS: all 100% organic

- A. Fertilizer: MicroLife organic fertilizer as supplied by San Jacinto Environmental Supplies, Houston, Texas or approved equal.
- B. Minor and Trace Elements: Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or Green Sand as supplied by Nature's Way Resources, Inc. or approved equals.

PART 3 EXECUTION

PLANTING

3.1 LAWN AND NATIVE SEED AREAS – Hydromulch and Sod

- A. After finish grade approval and before laying sod or spreading seed apply:
 - 1. 2" layer of compost uniformly across area
 - 2. 20# of MicroLife 6-2-4 fertilizer per 1,000 sq. ft.
 - 3. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.
 - 4. After laying sod or spreading seed, foliar spray the entire area with 8oz of MicroLife Super Seaweed mixed with a gal of water. Each gallon of mix to cover 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 2"-4" until the amendments are fully incorporated before seeding and/or planting (See Section 32 92 00).

3.2 SHADED GROUNDCOVER AREAS

- A. After finish grade approval apply:
 - 1. 1" layer of Compost uniformly across area
 - 2. 3" (in) Planting Soil
 - 3. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 - 4. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 4" until the amendments are fully incorporated before groundcover planting (See Section 32 92 00).

3.3 TREE PLANTING AREAS (Within Tree Excavation Pit)

- A. After finish grade approval before mulching apply:
 - 1. Backfill with a 50/50 blend of existing topsoil and Planting Soil
 - 2. For every 15 gal. tree size, add 6 oz. MicroLife Ultimate 8-4-6
 - 3. 3 oz of JRM Mycorrhizal Tree Transplant
 - 4. 2 oz of MicroLife Super Seaweed mixed with a gal. of water. Use 2 gal. of mixed solution per 15-gal. tree size

3.4 SUNNY GROUNDCOVER AND PERENNIAL AREAS

- A. After finish grade approval apply:
 - 1. 4"(in) Planting Soil
 - 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 - 3. 10# of MicroGro Granular per 1,000 sq. ft.

4. 2 oz of MicroLife Maximum Bloom 3-8-3 mixed with a gal. of water. Use as a root stimulator and thoroughly saturate the planting area.
- B. Disk or till into the soil to a depth of 6" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.5 SHRUB PLANTING

- A. After finish grade approval before mulching apply:
 1. 4"(in) Planting Soil
 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 6" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.6 EXISTING TREES (12"+ cal.)

- A. Once a year treatment
 1. 2 gal. of MicroLife Bio-Matrix 7-1-3
 2. 6 oz of JRM Mycorrhizal Injectables per 100 gal. of water

3.6 WEED CONTROL/TREATMENT

- A. All site locations to receive planting where weeds exist, shall be treated with post-emergent herbicide.
 1. Repeat treatment as required to ensure that no weeds are present at the beginning of work on the landscape planting of the Project.
- B. Weeds shall not be present at the date of inspection for Substantial Completion of the Project and at the conclusion of the maintenance and establishment period following acceptance of the Contractor's work.
- C. Post-emergent weed treatment includes:
 1. **Minimum of 14 days prior to soil preparation**
 2. Removal of weeds and other undesirable ground cover vegetation in turf/grass and planting areas shall be accomplished a minimum of 14 days prior to soil preparation for planting operations.
 3. Care shall be taken not to affect existing trees, shrubs, and plants on and near the site.
- D. Pre-Emergent Herbicide treatment:
 1. Apply per manufacturers distribution rate prior to mulching and directly after mulching.
 2. Snapshot, Princep or Specticle are approved Pre-Emergents. Contractor to submit product for approval.

END OF SECTION 32 91 00

SECTION 32 93 00 - PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.
5. Mulches
6. Gravels

B. Related Requirements:

1. Section 32 9200 "Lawns and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
2. Section 32 9100 "Soil Preparation"
 - a. Soil preparation and amendment shall be guided by tests described in this specification

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color **date-stamped photographs** in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting the true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and **name of the growing nursery**.
3. Irrigation inspection tube and cap materials.
4. Fertilizer tablets for tree installation

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

1. Mulch: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Gravel: 1-quart volume of all gravels used in project; in sealed plastic bags labeled with place of origin. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color and size variation.
3. Planting Soil Mix: 1-quart volume of soil required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup. Reference Section 32 9100 Soil Preparation for required properties.
4. Root Barrier: Manufacturer's information
5. Weed Control Barrier: 12" x 12".
6. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
7. Tree Staking Materials and Accessories: post, hose, and webbing (sample of each)

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in the successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Three years' experience in landscape installation in addition to requirements in Section 01 4000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Interior.
 - c. Landscape Industry Certified Horticultural Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 1. Selection of key trees shall be made by the Landscape Architect, who tags trees at their place of growth before they are prepared for transplanting. Notice of tree tagging will be indicated in the planting schedule.
- C. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before or after planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 2. Do not remove container-grown stock from containers before time of planting.
 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees: 1 year.
 - b. Shrubs, Vines, Ornamental Grasses, Ground Covers, Biennials, Perennials, and Other Plants: 1 year
 - c. Sod: 1 year
 - d. Annuals: Three months.
 - 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock,

densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.
- E. All plants not meeting these criteria will be rejected and replaced at no additional cost to the owner.

2.2 FERTILIZERS

- A. Trees: Ref 32 9100 "Soil Preparation" for fertilizer selection
- B. Shrub, groundcover, annuals and perennials: MicroLife all organic fertilizer as supplied by San Jacinto Environmental (713) 957-0909. Apply at mfg. max. recommended rates. Ref. Section 32 9100- "Soil Preparation"

2.3 MULCHES

- A. Mulch: Mulch shall be free of viable weed seeds and pathogens. Compost-based mulches shall be thermophilically composted (i.e., reach 131°F for a minimum of 15 days, per US Composting Council guidelines), and turned at least five times during this period to ensure uniform decomposition and sanitization. Testing documentation shall be submitted for approval prior to delivery.
 1. Type: Hardwood mulch
 2. Grind: 1.5"x2"max, Double Ground
 3. Color: Natural (Brown)
 4. Depth: 1.5" min 3.5" maximum
 5. C:N Ratio 20:1
- B. Compost: Ref 32 9100 "Soil Preparation"
- C. Rock Mulch:
 1. Decomposed Granite (ref. 32 1540 for gravel accessible surfaces)

- a. Size: ½"-1"
 - b. Clean, hard, durable particles of fragments of decomposed granite, "Salado Rose" or "Antique Grey" or "Black Star" available from Alamo Stone, Stafford, Texas (281) 240-4600 or approved equal.
 - c. Free of clay lumps, organic material, and deleterious material.
2. Seinna Cobbles
- a. Size: 50% 2"-4", 50% 6"-12"
 - b. Available from Alamo Stone, Stafford, Texas (281) 240-4600 or approved equal.

2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
- B. Mirafi 140 NL as manufactured by Nicolon Mirafi Group, Pendergrass, GA, (888) 795-0808 or approved equal.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer. Cross reference with 32 9100-Soil Preparation
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

- A. Stakes and Guys:

Contractor shall use staking materials necessary to meet requirements of specifications, subject to approval:

- 1. Tree Stakes: 7' & 8' long steel T-post weighing 1.33 pounds per foot.
- 2. Paint for Stakes: Pittsburgh Paint No. 515-5 Stonehenge Greige.
- 3. Tie Webbing: Tree Tie Webbing by AM Leonard-Green
- 4. Rootball Fixing Sub Surface Anchors: Platipus Anchors RF2P 3-Leg

2.7 LANDSCAPE EDGINGS

- A. Concrete Edging: Ref. Materials Schedule
- B. Steel Edging: Ref. Materials Schedule
- C. Aluminum Edging: Ref. Materials Schedule
- D. Bender Board Edging: Ref. Materials Schedule

2.8 MISCELLANEOUS PRODUCTS

- A. Root Barrier: Black, molded, modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, with vertical root deflecting ribs protruding 3/4 inch out from panel, and each panel 24 inches wide.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- E. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- F. Mycorrhizal Fungi: Dry, granular inoculants containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- D. Soil preparation and amendment shall be guided by tests described in Section 32 91 00.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Prior to planting, verify that planting soil has been installed to the specified depth and uniformly graded. Contractor shall notify the Landscape Architect of any areas where minimum soil depth requirements cannot be achieved.
- C. Soil Depths: Minimum planting soil depths shall be:
 - a. - Turf and Groundcover Areas: 6 inches
 - b. - Shrub Beds: 18 inches
 - c. - Tree Planting Zones: 36 inches diameter x 24 inches depth minimum
 - 1. Apply fertilizer directly to subgrade before loosening.

2. **Follow Soil Preparation Specification. Ref. 32 9100 for fertilization.**
3. Thoroughly blend planting soil off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
4. Spread planting soil to a depth indicated on the Drawings.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- F. Application of Mycorrhizal Fungi: Broadcast dry product uniformly over prepared soil at maximum application rate recommended by manufacturer.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 1. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 5. Maintain supervision of excavations during working hours.
 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
 7. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. **Follow Soil Preparation Execution. Ref. 03 9100**
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set B&B or container stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Use Blended Planting Soil for backfill. Follow Soil Preparation Specification. Ref. 329100
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. **Follow Soil Preparation Specification. Ref. 039100 for fertilization.**
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.
- E. Do not perform heading cuts or top trees.

3.7 TREE STAKING

- A. Staking of trees is to be used by the Contractor, who will be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables.

- B. Staking shall be completed immediately after planting. Plants shall stand plumb after staking.
- C. Stake all trees in accordance with the following table:

Tree	Stakes	Stake Size
15-45 Gal. and B&B under 3"	2	6 ft Post
65 Gal. and B&B 3"& larger	3	7 ft Post

- D. Locate first stake on prevailing windward side of tree and as close to the main trunk as is practical, avoiding root injury. Stakes shall be driven at least 18" into firm ground.
- E. Tie tree to stake using approved tree tie. Tie shall be located midway within tree crown or at a location approximately 2/3 of the overall height of the tree. Locate tie just above major side branch in order to deter slippage of tie.
- F. Locate second stake opposite first. Secure with one tie opposite upper tie at first stake.
- G. Auxiliary stem stakes shipped with trees shall be secured as above after shipping.

3.8 ROOT-BARRIER INSTALLATION

- A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings. Deep Root 24-2 or approved eq.
- B. Align root barrier vertically and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.
 - 1. Position top of root barrier flush with finish grade.
 - 2. Overlap root barrier a minimum of 12 inches at joints.
 - 3. Do not distort or bend root barrier during construction activities.
 - 4. Do not install root barrier surrounding the root ball of tree.
- D. Landscape Architect to provide approval through inspection prior to backfilling.

3.9 GROUND COVER AND PERENNIAL PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on the Drawings
- B. Use planting soil for backfill. Follow soil preparation execution. Re. 329100
- C. Dig holes large enough to allow spreading of roots.

- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: As indicated on the Drawings or 3"depth
 - 2. Organic Mulch in Planting Areas: As indicated on the Drawings or 3"depth
 - 3. Mineral Mulch in Planting Areas: As indicated on the Drawings

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Reference the Maintenance Specification 329400 for further information.
- E. Contractor shall keep a maintenance log and provide copies upon request.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas. Ref. 32 9100-Soil Preparation for clarifications.

- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations. Ref. 32 9100-Soil Preparation for clarifications.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.15 DECOMPOSED GRANITE/ GRAVEL

- A. Install soil separator below all gravel applications, reference planting details
- B. Install decomposed granite or gravel to depth and elevations indicated on the Drawings.

END OF SECTION 32 93 00

SECTION 32 94 00 - LANDSCAPE GROUNDS MAINTENANCE FOR NINETY (90) DAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Drawings, Division 0 and Division 1 apply to work under this Section.

1.2 SCOPE OF WORK:

A. Work included in Base Bid:

1. Monitoring adjustment and minor repair of the landscape irrigation system.
2. Mowing, edging and trimming of lawn areas.
3. Mowing of Love Grass and Native Grass Plantings
3. Pruning and trimming of plant materials.
4. Weed, cultivating and cleaning of planting beds, turf areas, and Native grass areas..
5. General site clean up; removal of trash and products of maintenance.
6. Applications of fertilizers, ant control, insecticides and herbicides.
7. Pruning and trimming of trees.
8. Mulching trees, shrubs, groundcovers and seasonal color.
9. Extra services as needed.

B. Work Not Included in Base Bid: (Extra Service)

1. Street cleaning - other than that required as a result of maintenance operations.
2. Replacement of plant material - other than that required under the one year warranty requirement.
3. Compost amendment application
4. Aerating lawn areas.
5. Overseeding with cool-season grasses.
6. Application of pre/post emergents.
7. Additional clean-up and/or plant material replacement relating to natural weather events including hurricanes, tornadoes, severe thunderstorms, major rain events causing flooding, freezing temperatures, ice/ice storms, extended periods of draught and snow.

1.3 EXTRA SERVICES:

The intent of the ninety day maintenance period is to provide a comprehensive maintenance program to include all required services, except those services specifically excluded, to perform the work for the stated time period.

1. All services not included in the list of Base Bid items shall be considered 'extra services' and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner's representative or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.
2. Such work may include replacement of dead plant materials other than what is already covered under the warranty period, major repairs of irrigation system, by-products of vandalism or other contracts or other site related work.

3. Application of pre/post emergents.
4. Authorized extra services work must be summarized weekly and submitted with receipts to the Owner's representative.
5. The Owner's representative is not bound by the specifications or contract to utilize the landscape maintenance contractor in the performance of "extra services" work.
6. The landscape maintenance contractor shall coordinate his activities with other contractors on the site so as to not hinder the performance of any work.
6. Authorized charges for extra work will be paid per the General Conditions of the Contract.

1.4 SUBSTITUTIONS:

- A. Specific reference to manufacturer's names and products specified in this Section are used as standards, but this implies no right to substitute other material or methods without written approval of the Owner's representative. Such permission must be secured without additional cost to Owner's representative.
- B. Installation of any approved substitution is Contractor's responsibility. Any changes required for installation of any approved substitution must be made to the satisfaction of and without additional cost to Owner's representative.

1.5 INTENT OF THE MAINTENANCE PROGRAM:

It is the intent of the maintenance program is to provide the Owner's representative with a project site that is attractive in appearance and keep all plant materials and lawns in a healthy and vigorous condition.

1.6 THE CONTRACT:

This Maintenance Contract is a period **ninety days**. The Contract can be terminated with cause.

1.7 CONTRACTORS PERFORMANCE:

The Contractor shall perform all work required once per week or as often as necessary to fulfill the spirit and intent of the Contract. The workmen shall be dressed in company uniforms and all required PPE (Personal Protective Equipment), and neat in appearance, perform their work in a professional manner, keep noise to a minimum and stage their work from a location on the site out of the way of the mainstream of the users. In general, the Contractor's presence on the site shall be as inconspicuous as possible.

1.8 COMMENCEMENT OF THE MAINTENANCE PERIOD:

This maintenance period shall become effective at the date of Substantial Completion.

1.9 NEGLECT AND VANDALISM:

1. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner's representative. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's representative's expense.
2. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's representative's expense.
3. All water damage, either natural or man-made, resulting from contractor's neglect shall be corrected at the contractor's expense.
4. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.12 EMERGENCIES:

1. The Contractor shall answer emergency or complaint calls within twelve (12) hours and corrective action shall be complete within twenty-four (24) hours.
2. The Contractor shall answer emergency calls regarding the Landscape Irrigation system failure or need of repair, and take corrective action within eight (8) hours. Such work, unless caused due to neglect on the part of the Landscape Maintenance Contractor, shall be considered "Extra Services".

1.13 JOB CONDITIONS:

- A. Contractor shall be familiar with all site conditions.

1.14 RESTRICTIONS:

- A. Do not use growth regulators or growth retardants or any chemicals that will have adverse effects on the organic fertilizers and soil conditioners utilized for this project.

PART 2 - PRODUCTS AND MACHINERY

2.1 MATERIALS:

Materials listed under this Section are expressly requested for use and does not prohibit or restrict the Contractor from providing other materials not listed in order to complete the work required herein.

1. Pre-Emergence Weed Control: Shall be Surflan A.S., Atrazine 4L or approved equal.
2. Post-Emergence Weed Control: Shall be Trimec Lawn Weed Killer, Sedge Hammer, Vantage, Image or approved equal.

3. Sufactant: Spreader Sticker shall be used with both pre and post emergence herbicides.
3. Herbicide: Shall be "Round Up", by Monsanto, St. Louis, Missouri.
4. Insecticide: Shall be "Astro Insecticide" as manufactured by FMC Corporation, Agricultural Products Group, 1735 Market Street, Philadelphia, PA 19103 (800.321.1362) or approved equal.
5. Fire Ant Control: Ortho Orthene Fire Ant Killer.
6. Compost: Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.
7. Fertilizer: FERTILIZERS AND NUTRIENT AMENDMENTS:
 - A. Fertilizer: MicroLife Hybrid 20-0-5, MicroLife Ultimate 6-2-4, and MicroLife Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or other approved equal supplier.
 - B. Contractor shall keep all empty bags with certificates intact and submit them to the Owner's representative.
 1. Submission of empty fertilizer bags is required to verify operation has been performed as specified.
 - C. Humate Soil Conditioner: Vigoro modified humate, Earthgreen Menefee Humate, Humate International AG 16-35 or approved equal.
 - D. Aerated Compost Tea: Natures Own or approved equal.
8. Tree Deep Feeding Fertilizer: Shall be Aerated Compost Tea with mycorrhizal fungi manufactured by Natures Own, MicroGrow or approved equal
9. Fungicide: Shall be "Systemic Fungicide" with Benomyl by Greenlight Products, San Antonio, Texas 78217, and/or Cleary Chemical 3336 WP "Turf and Ornamental Fungicide.
10. Fertilizer for annuals/perennials:

Nelson ColorStar Plus 19-13-6 with Fungicide

Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer
11. Soil Drenching Material: Shall be "Sub Due 2E", by the Agricultural Division of Ciba-Geigy Corporation, Greensboro, North Carolina 27409.
12. Mulch: Shall be equal to that already in use at the site. Shredded hardwood bark for groundcover areas.
13. Tree Stakes and Guys: Shall match those in use at the site.

2.2 MACHINERY:

Machinery requirements listed under this Section are not intended to be restrictions of specific manufacturers or models unless so stated. Specific mention of manufacturers is intended as a guide to illustrate the final product of maintenance operations desired.

1. Lawn Mowers: Shall be of the rotary type in good working order, finely tuned to protect the lawn from excessive exhaust fumes. Blades shall be sharp to reduce shredding of the cut grass blades.
2. Lawn Edgers: Shall be of a rigid or flexible blade type that will produce a fine clean edge where lawns meet walkways, pavements or curbs.
3. Fertilizer Spreaders: Cyclone type spreader or equal. No visible underlapping of applications will be permitted.
4. Deep Root Feeder: Shall be the Ross type by Ross Daniels, Incorporated, Des Moines, Iowa 50265.
5. Pruning Tools: Shall be maintained in good working order, cutting edges shall be sharp. Disinfect all tools when used for the removal of diseased limbs.

PART 3 - EXECUTION

3.1 LANDSCAPE IRRIGATION SYSTEM:

The Contractor shall monitor and program the automatic controlling devices to proceed optimum moisture levels in all planted areas.

1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner's representative, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
2. Do not program controllers operating on the same water meter to water during the same time period so as to prevent over-draft of water meters. Do not switch controller to "off" at any time, except as required for testing and for maintenance operations.
3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Monitor and inspect sprinklers once a month or upon request of the Owner's representative. This check shall include visual "inspection" of all accessible components of the irrigation system including but not limited to controllers, remote control valves, quick couplers and heads.
4. Adjust sprinklers to avoid damage to automobiles, signs and also adjust heads to keep water off the street and sidewalks. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
5. Minor repairs: Contractor shall make necessary repairs under \$300.00 without Owner's representative's approval to maintain operation of the system.

6. Replacement materials throughout the system shall be as specified in Section 02810.

3.2 TREES MAINTENANCE:

- A. Contractor shall maintain staking and guying of trees at all times and shall be responsible for any damage to trees or plant materials caused by chafing or breakage of foliage or limbs coming in contact with stakes or ties. Replace broken plant stakes and ties and bent stakes as needed. If ties are too tight, they must be replaced or adjusted. If stakes are not needed, remove.
- B. Trees that may require guys, stakes or special care during the winter winds and rains shall receive the required care prior to the time of rains and high winds to insure that no damage results to the plant material.
- C. All suckers shall be continually removed from trees.

3.3 SEASONAL AND PERENNIAL FLOWERS:

- A. The maintenance contractor shall continually maintain seasonal flower beds in all contract areas.
- B. Complete weeding, trimming, edging, and cultivation of all flower beds as required to keep the beds free of weeds, to promote growth and maintain neat, orderly appearance. As flowers cover open soil, cultivating shall be discontinued.
- C. Maintenance shall include:
 - 1. Pinching of blooms and pruning of dead or damaged foliage.
 - 2. Fertilize in alternate months with organic fertilizer. (RE: PART 2)
 - 3. Apply supplemental organic fertilizer to keep each type of seasonal flower performing at its optimum level.
 - 4. Spraying or dusting for disease or insect control as a preventive or corrective measure.
 - 5. Seasonal Color Change out: seasonal color change out after the initial planting (Extra Service) by the installing contractor.
- D. Fertilizer for annuals/perennials: Add ColorStar Plus 19-13-6 with Fungicide at the manufacturers recommended rate and feeding schedule. Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer (6 ounces per 1000 sq ft) & Garlic Oil (1 ounce per 1000 sq ft) mixed together with water and sprayed every 30 days.

3.4 HEDGE MAINTENANCE:

- A. Edge, weed, fertilize and cultivate all hedge beds in accordance with Schedule.

- B. Pruning of shrubs should create a uniformly dense plant, trapezoid in shape. Height as approved by Owner's representative. Selectively thin and tip back annually. Prune to enhance natural branching effect of plants. Do not change shape of shrubs by pruning.

3.5 GROUNDCOVER BEDS:

- A. Complete weeding, trimming, edging, and cultivating of all groundcover as required to keep the beds free of weeds, to promote growth and maintain neat, orderly appearance. As groundcovers cover open soil, cultivating shall be discontinued.
- B. Groundcover beds bordering on paved surfaces must be edged as needed to retain a neat edge. Do not trim vertically so as to expose stems and thatch.
- C. Fertilize all groundcovers with complete commercial fertilizer four times per year. (Extra Service)
- D. Replant all damaged or thin areas in groundcover beds at direction of the Owner's representative, at proper spacing.
- E. Slopes of 2:1 ratio, or steeper, shall not be cultivated due to erosion nuisance, unless otherwise instructed to cultivate by the Owner's representative.

3.6 TURF MAINTENANCE:

- A. Mowing: During periods of mild weather, mow at one and one-half (1 1/2") inches but during hot weather, the cut should be not lower than two (2") inches from the soil. Regular weekly mowing is required. Never scalp the lawn or cut more than one half the existing top growth in one mowing. Remove or catch the clippings, never allowing clippings to remain on lawn surface more than four (4) hours.

Allow grass to grow up to but not over sprinkler heads. Trim grass around heads with a circular sprinkler head trimmer. DO NOT USE LINE TRIM AROUND SPRINKLER HEADS.

- B. Watering: Provide a regular, deep watering program. The established turf should not be kept wet but should dry out somewhat between waterings. A twice weekly watering is good under regular conditions, but if it is hot or windy, water more often. In very hot weather, a fast watering with fine spray will cool the turf zone and can supplement the regular, deeper watering program. In shaded areas caused by trees or shrubs, water more frequently because of the competition for soil moisture. If lawn wilts (shows grey-brown) water more frequently.

- C. Lawn Fertilizer: Analysis based upon soil sample.

March 1	MicroLife Hybrid 20-0-5 applied at manufacturer's maximum recommended rate.

May 25	MicroLife Humates Plus 0-0-4 at manufacturer's maximum recommended rate.

July 18	Same as the March application.

MicroLife (6-2-4) at manufacturer's maximum recommended rate.

- D. **Weed Control:** Contractor shall use extreme care in the use of chemicals for weed control. Before such applications are made, the turf should be well established and in a vigorous condition. Broadleaf weeds such as malva, dandelion and plantain can be controlled with applications of selective and recommended herbicides. Always follow label directions fully and carefully; wash sprayer carefully after using herbicides.
- E. **Insects:** Control insects with regular applications of commercial insecticides at the manufacturer's recommended rate. Spray for insects once a month from mid-spring through summer as a preventative measure.
- F. **Diseases:** When they first appear, spray for diseases with an approved commercial fungicide strictly according to the manufacturer's recommendations.

3.7 NATIVE GRASSES MAINTENANCE

- A. Native grass mixes – Twice annually on or about June 1st and January 1st
- B. Above grasses shall be mowed to a 6" height.

3.8 CONTROL OF NOXIOUS WEEDS (Johnson Grass, Nut Grass, Poison Ivy, and other Noxious Weeds.)

- A. Noxious weeds shall be killed by using "Round Up" or other spray as approved by Owner's representative. Spray only foliage of grass to be eradicated, as this spray will kill any plant that it contacts.
- B. Irrigation to sprayed area should remain "off" for a period of three days following spray application. Repeat spray as required to kill completely.
- C. Apply pre/post-emergent weed killer as per manufacturer's recommendation as required by the "Schedule" and approved by Client prior to application.
- C. Weeds 30" or taller shall be removed/eradicated in Native Grass zones.

3.9 USE OF HERBICIDES, INSECTICIDES, AND STERILANTS:

- A. The Contractor is hereby granted permission to use such herbicides, insecticides, and sterilants as it may find necessary and advantageous in its grounds maintenance activities. Herbicides, insecticides, and sterilants, must be used responsibly and in conformance with Federal, State, and Local laws and regulations. The Contractor assumes all liability for damage and/or injury resulting from accident or misuse of these products and/or equipment. The Owner's representative retains the right to prohibit the use of any herbicide, insecticide, and sterilant that he may judge to be undesirable for any reason.
- B. Products leaving an undesirable residue or odor (i.e., weed oil) shall not be used.

- C. The Owner's representative shall be notified prior to application and advised of any danger associated with the use of these products (i.e., to avoid personal contact with sprayed areas, etc.).
- D. Apply insecticides as needed to protect all plant materials from damage. The insect control program shall include slugs and snails and advance preventive spraying for twig borers. The Contractor shall be responsible for the choosing of chemicals and insecticides he uses and shall be accountable for any misuse of same.
- E. Apply the proper fungicide, herbicide and pesticides for the control of pests, weeds and plant diseases or treat cuts on exposed surfaces of trees or shrubs for disease and pest control on turf, plants and trees.

3.10 GENERAL CLEAN UP:

- A. The Contractor shall dispose of all waste materials or refuse from his operations legally off the property except where agreement is reached with the Owner's representative.
- B. All plant growth shall be prevented in any cracks in walks or within paved areas.
- C. Leaves, papers, grass clippings or other debris shall be removed at least weekly or at each visit from all areas.
- D. Trash receptacles shall be checked regularly and emptied, and trash removed from the site frequently enough so that trash never overflows the receptacles. Trash receptacles shall be lined with black plastic bags which shall be emptied and removed from the site daily.

PART 4 - SCHEDULE

4.1 SCHEDULE:

The Schedule as included herein shall govern the work. Should the Contractor require an alteration of the Schedule, contact the Owner's representative.

JANUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf for the first time in week 4.

TREES, SHRUBS, AND VINES

Trees shall be pruned except flowering trees and flowering shrubs which shall be pruned after flowering. Do not change shape of tree, prune to enhance shape. Pre-emergent herbicides shall be applied if approved by Client. Weed beds as required.

FEBRUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf weeks 2 and 4.

TREES, SHRUBS, AND VINES

Continue pruning trees. Apply tree fertilizer to established trees. Deep root feeding is method to use during this period. Iron and other elements shall be applied if needed. Fertilize acid loving plants as called out under "Material Used". Do not fertilize flowering shrubs until blooming is completed.

MARCH: WEEKS 1,2

TURF

Turf shall be mowed in week two. Mowing shall not remove more than one-quarter (1/4") inch off existing height. First application of fertilizer (Microlife Hybrid 20-0-5) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize.

TREES, SHRUBS, AND VINES

Check Plants for adequate watering to prevent any winter damage. Water if necessary. Prune dead wood as required. Continue to weed beds.

Mulch shall be placed in all beds, a two (2") inch to three (3") inch layer over existing mulch if mulch is not adequate. Dead vines should be removed. Flowering plants should be fertilized only after blooming.

MARCH: WEEKS 3, 4

TURF

Mow as required; still only one-quarter (1/4") inch off existing growth. Water as required. Weed control should be continued. Replace any winter damaged sod at this time.

TREES, SHRUBS, AND VINES

Inspect evergreens for insects and diseases, spray as required. Spray for borers. Continue to weed beds. Fertilize trees and flowering shrubs if they have buds. Application should be 10-8-4 at a rate of ten (10) pounds per 1,000 square feet. Acid loving plants should be given special attention as called out in "Material Used".

APRIL: WEEKS 1, 2, 3, 4

TURF

Mowing should be continued; begin cutting one and one-half (1 1/2") inches to two (2") inches above grade. Water as required.

TREES, SHRUBS, AND VINES

Flowering plants should be through flowering and ready to be pruned and fertilized, if not already completed. Prune remaining dead wood from trees, shrubs, and vines, retaining natural shape. Continually remove all suckers on base of trees.

MAY: WEEKS 1, 2

TURF

Mowing shall continue once a week. During this period, it is important to note the soil moisture. Grasses may have been actively growing for about two and one-half (2 1/2) months, and need to be watered thoroughly.

TREES, SHRUBS, AND VINES

Inspect evergreens for mites and borers and spray as required. Inspect plants for scale insects and spray as required. Inspect flowering trees for powdery mildew and apply fungicide as required. Apply herbicide to shrub beds as required, using the same materials as in early spring. Weed beds as required. Water established trees at a rate of two (2") inches per week.

MAY: WEEKS 3, 4

TURF

Mow as required. Second application of fertilizer (Microlife Humates 0-0-4) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize. Particular attention shall be directed to the amount of water applied to turf.

TREES, SHRUBS, AND VINES

Continue to check plants for pests and control as required. Water any established plants as needed. Pruning shall cease until Fall. Apply fertilizer to acid loving plants again.

JUNE: WEEKS 1, 2, 3, 4

Mulching trees, shrubs, groundcovers and seasonal color.

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Mowing shall continue once per week. As the temperature rises, the mower should be raised one-half (1/2") inch to one (1") inch higher to maintain a good thick stand of grass. Inspect lawn for disease and inspect pests; apply fungicide only if necessary. Be alert for brown patch,

Bermuda decline and chinch bugs in Bermuda sod. Watch Bermuda for bare spots and underwatered areas.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any wood plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

JULY: WEEKS 1, 2, 3, 4

TURF

Mow weekly, maintain previous months height. Avoid watering in the middle of the day. Check turf for disease again, especially chinch bugs. Third application of fertilizer (Microlife Hybrid 20-0-5) should be applied at manufacturer's maximum recommended rate. Apply recommended controls as necessary.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any woody plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

AUGUST: WEEKS 1, 2, 3, 4

TURF

Mow weekly. Continue to irrigate as needed to keep turf from being stressed by lack of water. Inspect lawn for diseases. Apply necessary chemicals if needed; use caution.

TREES, SHRUBS, AND VINES

Continue to check trees, shrubs, and vines for adequate moisture around rootballs. No pruning shall be done during this period. Check all trees, shrubs, and vines for possible disease and insects, spray if necessary. Second application of fertilizer should be spread at manufacturer's maximum recommended rate.

SEPTEMBER: WEEKS 1, 2

TURF

Mow weekly. At this time lower mower to one and one-quarter (1 1/4") inches to one and one-half (1 1/2") inches. Irrigate as needed.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Root feed trees again. Acid type fertilizer and iron should be applied to trees, shrubs, and vines.

SEPTEMBER: WEEKS 3, 4

TURF

Mow weekly. Watch turf for diseases, apply chemicals as required.

TREES, SHRUBS, AND VINES

Maintain adequate soil moisture for all trees, shrubs, and vines. Prune only if necessary. Continue to check for any pests or disease, apply chemicals as required.

OCTOBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 1, 2 and 4. Watering can be reduced at this time. Continue to check for diseases. Fourth application of fertilizer (MicroLife 6-2-4) shall be applied at manufacturer's maximum recommended rate. Mow first; then fertilize. Water thoroughly after applying fertilizer. Turf should be thick and healthy for winter months. Overseed with annual rye grass at the rate of four (4) pounds per 1,000 square feet (only if requested by the Owner).

TREES, SHRUBS, AND VINES

Check trees for proper fertilization. Apply necessary elements, if inadequate. Pruning can be started lightly at this time. Weed beds as required. A two (2") inch layer of mulch shall be added on top of existing mulch.

NOVEMBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 2 and 4. Water less at this time.

TREES, SHRUBS, AND VINES

Examine plants for pests and spray as required. Do not use pesticides unless necessary. Weed beds as required.

DECEMBER: WEEKS 1, 2, 3, 4

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Last mowing shall be performed during first 2nd week of month. Rake leaves as required.

TREES, SHRUBS, AND VINES

Remove leaves from beds. Weed beds as required. Check plants for diseases, spray as required.

END OF SECTION 32 94 00