PROJECT MANUAL

Trona Valley Federal Credit Union



September 27, 2025

Stateline No. 7 Architects

TITLE PAGE

PROJECT:	TRONA VALLEY FEDERAL CREDIT UNION 1700 GATEWAY BLVD. ROCK SPRINGS, WYOMING 82901
OWNER:	TRONA VALLEY FEDERAL CREDIT UNION 840 HITCHING POST DRIVE GREEN RIVER, WYOMING 82935 CONTACT: JEREMY GIBSON, CEO
DATE:	SEPTEMBER 27, 2025
ARCHITECT:	STATELINE NO. 7 ARCHITECTS 444 SOUTH CENTER STREET CASPER, WYOMING 82601 (307) 265-3611 PRINCIPAL: LYLE T. MURTHA, AIA E-MAIL: lylem@stateline7.com
CIVIL ENGINEER:	WILLIAM H. SMITH AND ASSOCIATES 1515 9TH STREET, SUITE a ROCK SPRINGS, WYOMING 82901 (307) 362-6065 SHAWN ARNOLDI, P.E. E-MAIL: sarnoldi@whsmithpc.com
LANDSCAPE ARCHITECT:	TALLGRASS LANDSCAPE ARCHITECTURE 413 NORTH 4TH STREET CUSTER, SOUTH DAKOTA 57730 (605) 673-6984 MATT FRIDELL, ASLA E-MAIL: matt@tallgrasslandscapearchitecture.com
STRUCTURAL ENGINEER:	LOWER & COMPANY, P.C. 1607 CY AVENUE, SUITE 201 CASPER, WYOMING 82604 (307) 234-6984 BOB LOWER, P.E. E-MAIL: lowerco@lowerco.com

MECHANICAL ENGINEER:

ENGINEERING DESIGN ASSOCIATES
1607 CY AVENUE, SUITE 303
CASPER, WYOMING 82604
(307) 266-5033
JAK PEDEN HOLLINGER, P.E.
E-MAIL: jak@edaengineering.com

ELECTRICAL ENGINEER:

ENGINEERING DESIGN ASSOCIATES
1607 CY AVENUE, SUITE 303
CASPER, WYOMING 82604
(307) 266-5033
MONTE N. SCHAFF, P.E.
E-MAIL: mschaff@edaengineering.com

FIRE PROTECTION ENGINEER:

JENSEN HUGHES
10170 CHRUCH RANCH WAY, SUITE 200
WESTMINSTER, COLORADO 80021
(303) 439-0485
AARON ELSTON, P.E.
E-MAIL: aelston@jensenhughes.com

I hereby certify that this specification together with the accompanying contract documents was prepared by me under my direct supervision and that I am a duly Registered Architect under the laws of Wyoming.



TRONA VALLEY FEDERAL CREDIT UNION

TABLE OF CONTENTS

Title Page
Table of Contents
Advertisement for Bid
Instructions to Bidders
Bidder's Checklist
Sealed Envelope Outline Example
Asbestos Statement
Bid Form
Product Substitution Request
Bid Bond - AIA Document A310*
Standard Form of Agreement Between Owner and Contractor – AIA Document A101*
Standard General Conditions of the Construction Contract – AIA Document A201*
Supplemental General Conditions
Performance Bond - AIA Document A312*
Labor and Material Payment Bond - AIA Document A312*

* **Sample AIA documents available by request from the Architect or from the American Institute of Architects**

TECHNICAL SPECIFICATIONS : **Pages**

DIVISION 1 - GENERAL REQUIREMENTS

01 1000 - Summary	1 - 1
01 2000 - Price and Payment Procedures	1 - 3
01 2300 - Alternates	1 - 1
01 2500 - Substitution Procedures	1 - 2
01 3000 - Administrative Requirements	1 - 7
01 3553 - Security Procedures	1 - 1
01 4000 - Quality Requirements	1 - 5
01 4219 - Reference Standards	1 - 4
01 5000 - Temporary Facilities and Controls	1 - 2
01 6000 - Product Requirements	1 - 4
01 7000 - Execution and Closeout Requirements	1 - 7
01 7800 - Closeout Submittals	1 - 4
01 7900 - Demonstration and Training	1 - 3

DIVISION 3 - CONCRETE

03 3000 - Cast-In-Place Concrete	1 - 14

DIVISION 4 - MASONRY

04 2000 - Unit Masonry	1 - 4
04 4313 - Stone Masonry Veneer	1 - 3

DIVISION 5 - METALS

05 1200 - Structural Steel	1 - 9
05 2100 - Steel Joists	1 - 3
05 3100 - Steel Decking	1 - 6
05 5400 - Cold-Formed Metal Framing	1 - 8
05 5500 - Metal Fabrications	1 - 6
05 5213 - Pipe and Tube Railings	1 - 2
05 7000 - Decorative Metal	1 - 3
05 7300-A - Exterior Decorative Metal Railings	1 - 4
05 7300-B - Revamp Exterior Decorative Metal Railings	1 - 3

DIVISION 6 - WOODS, PLASTICS, AND COMPOSITES

06 0573 - Wood Treatment	1 - 1
06 1000 - Rough Carpentry	1 - 4
06 1053 - Landscape Rough Carpentry	1 - 3
06 2000 - Finish Carpentry	1 - 2
06 4100 - Architectural Wood Casework	1 - 3
06 8316 - Fiberglass Reinforced Paneling	1 - 2

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07 0553 - Fire and Smoke Assembly Identification	1 - 1
07 1113 - Bituminous Dampproofing	1 - 2
07 1300 - Sheet Waterproofing	1 - 3
07 2100 - Thermal Insulation	1 - 2
07 2119 - Foamed-In-Place Insulation	1 - 2
07 4213 - Metal Wall Panels	1 - 4
07 5300 - Elastomeric Membrane Roofing	1 - 5
07 7123 - Manufactured Gutters and Downspouts	1 - 2
07 7200 - Roof Accessories	1 - 2
07 8400 - Firestopping	1 - 2
07 9200 - Joint Sealants	1 - 3

DIVISION 8 - OPENINGS

08 1113 - Hollow Metal Doors and Frames	1 - 5
08 1416 - Flush Wood Doors	1 - 4
08 3100 - Access Doors and Panels	1 - 2
08 3200 - Sliding Glass Doors	1 - 3
08 4313 - Aluminum Framed Storefronts	1 - 5
08 7100 - Door Hardware	1 - 39
08 8000 - Glazing	1 - 4
08 8300 - Mirrors	1 - 2
08 9100 - Louvers	1 - 3

DIVISION 9 - FINISHES

09 2116 - Gypsum Board Assemblies	1 - 6
09 3000 - Tiling	1 - 4
09 5100 - Acoustical Ceilings	1 - 4
09 5426 - Suspended Wood Ceilings	1 - 2
09 6500 - Resilient Flooring	1 - 3
09 6566 - Resilient Athletic Flooring	1 - 2
09 6813 - Tile Carpeting	1 - 3
09 8430 - Sound-Absorbing Wall and Ceiling Units	1 - 2
09 9113 - Exterior Painting	1 - 4
09 9123 - Interior Painting	1 - 5
09 9300 - Staining and Transparent Finishing	1 - 3
09 9600 - High-Performance Coatings	1 - 3

DIVISION 10 - SPECIALTIES

10 1100 - Visual Display Units	1 - 2
10 1416 - Plaques	1 - 1
10 1423 - Panel Signage	1 - 2
10 2113.19 - Plastic Toilet Compartments - ASI	1 - 4
10 2800 - Toilet, Bath, And Laundry Accessories	1 - 3
10 3100 - Manufactured Fireplaces	1 - 2
10 4400 - Fire Protection Specialties	1 - 2
10 5123 - Plastic-Laminate-Clad Lockers	1 - 2
10 5617 - Wall Mounted Standards and Shelving	1 - 2

DIVISION 12 - FURNISHINGS

12 2400 - Window Shades	1 - 4
12 3600 - Countertops	1 - 4

DIVISION 14 – CONVEYING SYSTEMS

14 2100 – Electric Traction Elevators	1 - 8

DIVISION 20 - GENERAL MECHANICAL REQUIREMENTS

20 0500 - General Plumbing and HVAC	1 - 12
20 0510 - Motor Requirements	1 - 4
20 0515 - Common Work Results	1 - 5
20 0520 - Meters and Gauges	1 - 4
29 0525 - General Duty Valves	1 - 4
20 0530 - Hangers and Supports	1 - 7
20 0550 - Mechanical Identification	1 - 4
20 0590 - Testing, Adjusting, And Balancing	1 - 19
20 0710 - Mechanical Insulation	1 - 5

DIVISION 21 - FIRE SUPPRESSION

21 1313 - Wet-Pipe Sprinkler Systems	1 - 23
21 1319 - Preaction Sprinkler Systems	1 - 14

DIVISION 22 - PLUMBING

22 1110 - Domestic Water Piping	1 - 7
22 1120 - Domestic Water Piping Specialties	1 - 5
22 1130 - Domestic Water Pumps	1 - 3
22 1310 - Drain Waste & Vent Piping	1 - 6
22 1320 - Drain Wate & Vent Piping Specialties	1 - 4
22 3000 - Plumbing Equipment	1 - 3
22 4200 - Plumbing Fixtures	1 - 9

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

23 1110 - Fuel Gas Piping	1 - 6
23 1120 - Fuel Gas Piping Specialties	1 - 3
23 2110 - Hydronic Piping	1 - 8
23 2120 - Hydronic Specialties	1 - 6
23 2130 - Hydronic Pumps	1 - 6
23 2310 - Refrigerant Piping	1 - 6
23 2510 - HVAC Water Treatment	1 - 7
23 3110 - HVAC Metal Ductwork	1 - 10
23 3300 - HVAC Duct Accessories	1 - 7
23 3420 - Power Ventilators	1 - 4
23 3610 - Air Terminal Units	1 - 4
23 3710 - Grilles, Registers, And Diffusers	1 - 3
23 5110 - Gas Vents and Chimneys	1 - 5
23 5210 - Modulating Condensing Boilers	1 - 7
23 6420 - Scroll-Type Water Chillers	1 - 9
23 7320 - Modular Air Handling Units	1 - 9
23 8110 - Terminal Heating Units	1 - 3
23 8125 - Computer-Room Air Conditioners	1 - 5

DIVISION 25 - INTEGRATED AUTOMATION

25 1500 - Building Automation System	1 - 32
25 3500 - Controls Instrumentation	1 - 9
25 3510 - Control Valves and Actuators	1 - 8
25 3520 - Control Dampers and Actuators	1 - 7
25 3530 - Flow Stations and Flow Meters	1 - 5
25 3550 - Variable Frequency Controllers	1 - 5
25 9500 - BAS Drawings and Sequences	1 - 13
25 9504 - Chilled Water Loop Pumps	1 - 2
25 9506 - Heating Water Loop Pumps	1 - 2
25 9512 - Air-Cooled Water Chillers	1 - 2
25 9528 - Small Capacity Boilers	1 - 2
25 9532 - Multiple Zone Air Handlers	1 - 6
25 9562 - Air Terminal Units	1 - 3
25 9598 - Misc Sequences	1 - 2

DIVISION 26 - ELECTRICAL

26 0010 - General Electrical Requirements	1 - 11
26 0519 - Low-Voltage Electrical Power Conductors and Cables	1 - 9
26 0526 - Grounding and Bonding for Electrical Systems	1 - 6
26 0529 - Hangers and Supports for Electrical Systems	1 - 4
26 0533 - Conduit for Electrical Systems	1 - 10
26 0534 - Boxes for Electrical Systems	1 - 6
26 0536 - Cable Trays for Electrical Systems	1 - 5
26 0553 - Identification for Electrical Systems	1 - 6
26 0583 - Wiring Connections	1 - 3
26 0923 - Lighting Control Devices	1 - 6
26 2100 - Low-Voltage Electrical Service Entrance	1 - 3
26 2200 - Low-Voltage Transformers	1 - 4
26 2416 - Panelboards	1 - 8
26 2726 - Wiring Devices	1 - 8
26 2813 - Fuses	1 - 2
26 2816 - Enclosed Switches	1 - 4
26 2913 - Enclosed Controllers	1 - 5
26 3213 - Engine Generators	1 - 11
26 3600 - Transfer Switches	1 - 10
26 4300 - Surge Protection Devices	1 - 6
26 5100 - Interior Lighting	1 - 7
26 5600 - Exterior Lighting	1 - 5

DIVISION 27 – COMMUNICATIONS

27 1000 - Structured Cabling and Equipment for Voice and Data	1 - 11

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 4600 - Fire Detection and Alarm	1 - 21

DIVISION 31 - EARTHWORK

31 0000 - Earthwork	1 - 11
31 1000 - Site Clearing	1 - 4
31 2000 - Earth Moving	1 - 11
31 2300 - Trenching	1 - 3
31 3000 - Water Distribution	1 - 11
31 4000 - Sanitary Sewerage	1 - 6
31 6329 - Drilled Piers	1 - 7

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 1216 - Asphalt Paving	1 - 6
32 1313 - Concrete Paving	1 - 11
32 1373 - Concrete Paving Joint Sealants	1 - 4
32 1500 - Aggregate Surfacing	1 - 1
32 1713 - Parking Bumpers	1 - 2
32 1726 - Tactile Warning Surfacing	1 - 2
32 3223 - Segmental Retaining Wall	1 - 9
32 3300 - Site Furnishings	1 - 2
32 3313 - Site Bicycle Racks	1 - 2
32 8423 - Underground Sprinklers	1 - 3
32 9119 - Landscape Grading	1 - 2
32 9219 - Seeding	1 - 6
32 9223 - Sodding	1 - 4
32 9300 - Plantings	1 - 9

DIVISION 33 - SITE UTILITIES

33 4100 - Storm Utility Drainage Pipe	1 - 14
33 4600 - Subdrainage	1 - 5

APPENDIX – SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING REPORT

TRONA VALLEY FEDERAL CREDIT UNION HEADQUARTERS	1 - 55
PAVEMENT DESIGN ADDENDUM	1 - 4

END OF TABLE OF CONTENTS

ADVERTISEMENT FOR BID

Plans will be available on October 20th, 2025 for the project known as Trona Valley Federal Credit Union, 1700 Gateway Blvd., Rock Springs, Wyoming. Sealed bids will be received by the office of the owner of the project at Trona Valley Federal Credit Union, 840 Hitching Post Drive, Green River, Wyoming 82935 on Tuesday, November 25th, 2025 until 1:30 p.m. local time for labor and materials to construct the Trona Valley Federal Credit Union, 1700 Gateway Blvd., Rock Springs, Wyoming. The bid opening will be private (not open to bidders or the public).

A single contract will be awarded for the General, Civil, Landscape, Structural, Architectural, Mechanical, Electrical, and Fire Protection work as drawn and specified in the Plans and Specifications. Bid Security will be required. Performance and Labor and Material Payment Bonds in the amount of 100% of the contract will also be required. The estimated value of the construction is approximately $ 18,087,410.50. This is a General Contractor "invitation to bid" only. Interest from subcontractors located within Wyoming is encouraged.

Copies of the Plans and Specifications will be available digitally only, however bidders are encouraged to include their names on the bidders list at the office of the Architects: Stateline No. 7 Architects, 444 South Center Street, Casper, Wyoming 82601, telephone number (307)-265-3611, attn: Lyle Murtha, AIA.

A pre-bid meeting for General Contractors will NOT be conducted.

The project consists of three floor levels of new construction including drilled pier foundations with steel post-and-beam structure with structural floors and steel joist and concrete deck construction. The new building area includes approximately 29,481 gross square feet of building. The work includes exterior sitework; exterior concrete flatwork, paving, retaining walls, and landscaping; cast-in-place concrete; masonry (stone); steel framing; misc. steel; wood doors and hollow metal frames; aluminum storefront windows; batt and rigid insulation; wood and metal framing; interior finish carpentry; metal panel siding; membrane roofing; wood ceilings and soffits; acoustical grid ceilings; a traction elevator; interior and exterior painting and stain; gypsum board; rubber base; carpet; sheet vinyl; porcelain floor and wall tile; toilet partitions and toilet accessories; quartz countertops; granite countertops; solid surface countertops; plastic laminate countertops; plumbing and plumbing fixtures; fire protection system; HVAC equipment; fire alarm system; electrical wiring and interior and exterior light fixtures; and other miscellaneous items.

Owner of the Project

Trona Valley Federal Credit Union
840 Hitching Post Drive
Green River, Wyoming 82935
Contact: Jeremy Gibson, CEO

Project

Trona Valley Federal Credit Union
1700 Gateway Blvd.
Rock Springs, Wyoming 82901

INSTRUCTIONS TO BIDDERS

I. SUMMARY OF THE PROJECT:

The project consists of one prime contract for the construction of three floor levels of new construction including drilled pier foundations with steel post-and-beam structure with structural floors and steel joist and concrete deck construction located at 1700 Gateway Blvd., Rock Springs, Wyoming. The new building area includes approximately 29,481 gross square feet. The project includes all Sitework, General, Civil, Landscape, Structural, Mechanical, Electrical, and Fire Protection work on the drawings and specified herein.

All other Owner furnished, Contractor installed (OFCI) items, as identified in the Plans and Specifications, will be coordinated as outlined in the Supplemental General Conditions.

II BIDDERS SITE VISIT:

A pre-bid site visit for General Contractors will NOT be conducted. Sitework contractors are encouraged to make a site visit prior to the bid. No extra compensation will be allowed for items and/or conditions that were present at the project site and should have been noted prior to bidding.

III CONTRACT DOCUMENTS:

The following constitute the Contract Documents that will be included as a part of the Contract and Bid Proposal:

Instructions to Bidders
Asbestos Statement
Standard Form of Agreement Between Owner and Contractor – AIA Document A101
Standard General Conditions of the Construction Contract – AIA Document A201
Standard Supplementary Conditions
General Requirements - Division 1
Technical Specifications - Divisions 2 through 32
Addenda
Architectural Drawings prepared by Stateline No. 7 Architects
Civil Drawings prepared by Willian H. Smith & Associates
Landscape Drawing prepared by Tallgrass Landscape Architects
Structural Drawings prepared by Lower & Company, P.C.
Mechanical and Electrical Drawings prepared by Engineering Design Associates
Fire Protection Drawings prepared by Jensen Hughes

IV INTERPRETATION OF CONTRACT DOCUMENTS:

If a person contemplating the submission of a Proposal for the proposed Contract is in doubt as to the meaning of any part of the Drawings and Project Manual, or other proposed contract documents, or should errors, omissions or discrepancies in or between Drawings and Specifications exist or appear to exist, he/she shall submit to the Architect a written request for interpretation or clarification thereof at least seven (7) days prior to the scheduled time for closing of bids. The person submitting the request shall be responsible for its prompt delivery. Any interpretation or clarification of the Contract Documents shall be made in writing and by addendum duly issued, and a copy of such addendum will be available to all bidders. The Owner will not be responsible for any other explanation or interpretation of the Contract Documents. Receipt of addendum by Bidders shall be acknowledged on the Bid Proposal. No oral explanation or interpretations will be made or acknowledged by the Architect.

V SUB-HEADINGS AND TITLES:

The titles or sub-headings used in this Contract and in the Contract Documents are understood to be for convenience of reference only and shall not be taken or considered as being a part thereof, or as having any bearing on the interpretation thereof.

VI SUBSTITUTION OF MATERIALS:

Materials or products specified by trade name, manufacturer's name or catalog number shall be provided as specified. Substitutions will be permitted only by one of the following methods:

1. **Prior to the Award of the Contract, interested parties may request approval of substitute materials. Such request shall be made in writing on the Product Substitution Form included and delivered to the Architect no later than ten (10) days prior to receipt of bids. In order to establish a basis of quality, certain materials or articles are specified by designating one or more manufacturers' names, brands, or numbers. Whenever a material, article or piece of equipment is identified on the Drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or piece of equipment so proposed is, in the opinion of the architect, of equal substance, appearance and function. All substitutions approved will be listed in an Addendum.**

2. **If a material is specified by manufacturer's name and/or several manufacturers are listed, any of those mentioned will be considered as acceptable. The first name mentioned will be the product on which the Drawings are based, and space requirements and details are designed to work with the product. It shall be the responsibility of the Contractor to verify that the product he/she proposes meets all space and detail requirements.**

3. **If a material is specified herein stating "equal to" a manufacturer's product, then similar products of equal quality will be considered. It shall be the responsibility of the Contractor to submit proof, if required, of the product specified. If material herein specified states "prior approved equal", such material shall have written approval before bidding, in accordance with (1) above.**

4. **If a material is not mentioned by manufacturer's name, but only by technical characteristics, any product meeting these characteristics will be considered.**

Products covered by Paragraphs (3) and (4) above, if other than those named in the Specifications, shall be submitted for approval not more than thirty (30) days after award of Contract. If no submittal is made within the thirty-day time limit, the Contractor will be required to furnish the specified products. Proposals for substitutions shall be accompanied by complete data and samples.

VII OR EQUAL PHRASE:

Where the phrase "or equal" or "or equal as approved by the A/E" occurs in the Contract Documents, materials or methods will not be approved as equal by the Architect unless the item has been specifically done so in writing in accordance with VI, 3 above.

VIII AVAILABILITY OF SPECIFIED ITEMS:

Verify prior to bidding that all specified items will be available in time for installation during orderly and timely progress of the Work. In the event any specified item or items will not be so available, so notify the Architect prior to date of receipt of bids.

IX NOTIFICATION OF ACCEPTANCE OF BID PROPOSAL:

The Owner will, upon review and acceptance of Proof of Competency or if none required, after opening of bids, notify the successful Bidder of the acceptance of his Proposal (within 45 days).

X INDEMNITY:

The Contractor shall indemnify and save harmless the Owner from and against all losses and all claims, demands, payment, suits, actions, recoveries, and judgments of every nature and description brought or recovered against him, by reason of any negligent act or omission of the said Contractor, his agents or employees, in the execution of the Work or in the guarding of it and this shall include acts or omission of Subcontractor.

The Contractor shall, and is hereby required to, maintain such insurance, issued in the name of the Owner, as will protect the Owner from his contingent liability under this Contract, and the Owner's right to enforce against the Contractor any provision of this Section shall be contingent upon the full compliance by the Owner with the terms of applicable insurance policy or policies, a copy of which shall be deposited with the Owner.

XI CONTRACTOR LIABILITY INSURANCE:

The Contractor shall maintain insurance as will protect him from claims under Workmen's Compensation Acts and from any other claims for damages for personal injury, bodily injury, and property damage which may arise from the Contractor's acts or by any Subcontractor or anyone directly or indirectly employed by either of them.

XII CONTINUATION OF LIABILITY POLICIES:

Contractor shall maintain liability policies throughout the one-year project warranty period following the construction.

XIII INSURANCE CERTIFICATES:

Without limiting any of the other obligations or liabilities of the Contractor, the Contractor shall provide and maintain, until the Work is completed and accepted by the Owner, minimum insurance coverages in accordance with requirements herein provided for on AIA Document G715. Insurance must be written by a Best's rated company of B+ or better rating.

Copies of AIA Document G715 will be supplied by the Architect to the Contractor for completion by his insurance carrier or agent. The AIA Document G715 shall be sufficient in number to furnish: (1) Contractor and his insurance carrier or agent with their needs, and (2) two copies for the Owner.

The Contractor's insurance carrier or agents shall complete the Owner's copy of Certificates in sufficient time to allow for review and approval by the Owner's Attorneys prior to the actual start of the Work by the Contractor.

The Insurance Requirements AIA Document G715 will designate the party to receive the completed AIA Document G715, and this party will be responsible to see that such forms are received and approved by the Owner's Attorneys prior to commencement of any work under this Contract. He/she will also be responsible to see that renewal forms are submitted and approved if the Work is to extend beyond the expiration dates of coverages approved by the Owner's Attorneys.

Such insurance shall not be written for amounts less than the following:

Workmen's Compensation as required by all applicable Federal, State, or other laws including Employers' Liability with a limit of at least:	**$ 1,000,000**
Comprehensive General Liability all on the occurrence basis including:	
Contractor's Liability	
Contingent Liability	
Contractual Liability	
Completed Operations (kept in force for at least two years after date of final completion)	
Products' Liability	
Broad Form Property Damage	
Remove XCU exclusions (explosion, collapse, underground property damage)	
Total	**$ 2,000,000**
Personal Injury: Eliminate the exclusion for claims sustained by any person as a result of an offense directly or indirectly related to the employment of such person	
Each Occurrence	**$1,000,000**
Aggregate	**$1,000,000**
Bodily Injury:	
Each Person	**$1,000,000**
Each Occurrence	**$1,000,000**
Property Damage:	
Each Accident	**$1,000,000**
Aggregate	**$1,000,000**
Combination of underlaying Comprehensive Liability for lesser limits with remaining limits provided by Excess or Umbrella Liability	

Comprehensive Automobile Liability including non-ownership and hired car coverage as well as owned vehicles:

Bodily Injury:

Each Person	**$1,000,000**
Each Occurrence	**$1,000,000**

Property Damage:

Each Occurrence	**$1,000,000**

Builders' Risk Insurance:

The Contractor will purchase permanent builders' risk insurance for the construction for the duration of the project.

It is a condition of the Contract that the policy or policies waive any and all governmental immunity as a defense in any action brought against the insured.

Approval of the insurance by the Owner shall not in any way relieve or decrease the liability of the Contractor hereunder and it is expressly understood that the Owner or the Architect does not in any way represent that the above required insurance or limits of liability are sufficient or adequate to protect the Contractor.

Evidence of the above required insurance shall be furnished only on AIA Document G715, "Certificate of Insurance," unless further verification of coverage is requested by the Owner.

It shall be the sole responsibility of the Contractor to maintain as minimum coverage, insurance on the Work against the perils of fire and extended coverage in an amount equal to the full value of the newly constructed property at risk (Builders' Risk Insurance). In addition, the Contractor shall be solely responsible for payment of any amounts which may become payable as a result of any co-insurance penalty, deductible provision, corridor, or self-insured retention provision of the policy or policies, as well as all losses arising out of any uninsured perils.

It is a condition of the Contract that the Owner, the Owner's Architect, and all Contractors, Subcontractors, and their corporate sureties waive all rights of recovery against each other for damages caused by fire or other perils to the extent such damages are covered by any valid or collectible insurance, and further, that all property insurance policies shall include the standard "waiver of subrogation" clause.

XIV FORM OF CONTRACT:

The form of the Contract shall be the latest edition of AIA Document No. A101, "The Standard Form of Agreement Between Owner and Contractor"; copies of this form are on file and available for examination at the office of the Architect or from the American Institute of Architects.

XV COPIES OF CONTRACT:

Not less than three (3) copies of the Owner/Contractor Agreement, AIA Document A101, shall be prepared. Additional copies shall be filed where and as may be required.

XVI AWARD OF CONTRACT:

The Owner reserves the right to reject any and all bids or parts thereof, and to waive any irregularities therein. Add and Deduct alternate bids may be accepted or rejected in any order or in any combination as deemed appropriate to the owner.

XVII NOTICE TO PROCEED:

Upon approval by Owner of the Contract Security and Certificate of Insurance and upon execution of the Agreement Between Owner and Contractor, the Owner will issue to the Contractor a Notice to Proceed within 10 days thereafter. The Owner reserves the right, however, to issue the Notice to Proceed following the receipt of Contract Security and Insurance Certificates.

Upon receipt of the Notice to Proceed from the Owner, the Contractor shall sign and date each copy received and shall retain one copy for his files, return two copies to the Owner and transmit one copy to the Architect. The Contractor shall sign, date and return the Notice within 10 days after receipt from the Owner.

XVIII TIME OF START OF WORK:

The starting date for the Work shall be considered to be the date of the Contractor's signature on the Notice to Proceed, as described above.

XIX TIME OF COMPLETION:

Work shall be substantially completed 540 calendar days from the date the Contractor signs the Notice to Proceed.

Work must be completed to attain substantial completion within the time limit as set forth above and, since time is of the essence, Bidders shall base their bids on furnishing sufficient forces and working such shifts as may be required to ensure substantial completion of the Contract Work on or before the date.

Should the Contractor fail to substantially complete the work within the time agreed upon in the contract documents, or within such extra time as may have been allowed by increases in the contract or by formally approved extensions granted by the Owner, the Contractor and the Contractor's surety shall be liable for and shall pay the Owner the sums herein after stipulated as liquidated damages for each calendar day of delay until the work is substantially complete: $ 2,500.00 per day. This sum shall be considered and treated not as a penalty but as liquidated damages due the Owner from the Contractor by reason of inconvenience, added costs of engineering and supervision, and other items which have caused an expenditure of additional funds resulting from the contractor's failure to complete the work within the time specified in the contract.

XX PERMITS:

The General Contractor shall be responsible for applying for, purchasing, and obtaining all building permits and utility taps and associated fees.

END OF INSTRUCTIONS TO BIDDERS

BIDDER'S CHECKLIST

- ☐ All blanks on the Bid Form are filled in.

- ☐ Receipt of all addenda is noted on the Bid.

- ☐ Bid is signed by an officer of the corporation or, if not a corporation, a proprietor or partner.

- ☐ 10% Bid Bond or 5% Security is included (payable to Trona Valley Federal Credit Union).

- ☐ All above listed forms shall be enclosed in a sealed opaque envelope. The envelope shall state the Bidder's name and address, shall state: "SEALED BID ENCLOSED", and shall be addressed to (see the Sealed Envelope Outline example on the following page):

Return Address
John Smith
Contractor
Box 1
Anytown, USA

To: Trona Valley Federal Credit Union
c/o: Jeremy Gibson, CEO
840 Hitching Post Drive
Green River, Wyoming 82935

SEALED BID ENCLOSED: Bid For Trona Valley Federal Credit Union

ASBESTOS STATEMENT

No asbestos-containing materials have been specified for this project and none shall be installed. Upon completion of this project all subcontractors and material suppliers shall provide the owner a letter stating that no asbestos-containing materials were used in the construction of this facility.

BID FORM
TRONA VALLEY FEDERAL CREDIT UNION
1700 GATEWAY BLVD.
ROCK SPRINGS, WYOMING

This proposal is herewith submitted in accordance with your Advertisement inviting proposals to be received for the project identified as:

Trona Valley Federal Credit Union
1700 Gateway Blvd.
Rock Springs, Wyoming

The undersigned herein agrees to furnish all labor, materials, equipment and services to accomplish the work required in accordance with the contract documents including Addendum Numbers ____, ____, ____, and ____, issued thereto for the following sums:

BASE BID: Total project including General, Civil, Landscape, Structural, Architectural, Mechanical, Fire Protection, and Electrical items shown on the plans and described in these specifications.

For the Sum of:_____Dollars ($_____)

VEHICLE CANOPY ALTERNATE: Provide for a pre-engineered metal building vehicle canopy shelter complete as shown on the landscape plans and described in these specifications.

For the Sum of:_____Dollars ($_____)

DROP-OFF SHELTER ALTERNATE: Provide for a pre-engineered metal building drop-off shelter complete as shown on the landscape plans and described in these specifications.

For the Sum of:_____Dollars ($_____)

In submitting this proposal, it is understood that the right is reserved by the Owner to reject any and all bids and all proposals or to waive any informalities therein, and it is agreed that this proposal may not be withdrawn for a period of **45 day**s after the date of opening of these proposals.

If a Corporation, name of State in corporated in: _____

If a Partnership, state full names of all co-partners: _____

_____

_____

_____

Date: _____, 2025 Firm Name:_____

By (signature):_____ Official Address:_____

Title:_____ (Seal below, if any)

PRODUCT SUBSTITUTION REQUEST

Stateline No 7 ARCHITECTS

PROJECT: Trona Valley Federal Credit Union PROJECT #: 23-018

FIRM NAME/ADDRESS/PHONE-FAX # OF PROPOSER_____

_____

_____

_____

_____

ATTN:_____

DATE RECEIVED:_____

SUBSTITUTION DEADLINE: Minimum of 10 days prior to the bid date

This Product Substitution Request must be submitted with all substitution requests, or the request may not be considered.

The substitution request must be received at the Architect's office no later than the date indicated above, or the request will not be considered.

By signing below, bidder acknowledges that they are providing a Certificate of Equal Performance and Assumption of Liability for Equal Performance.

Signature_____ **Title**_____

PRODUCT SPECIFIED_____

DIVISION/SECTION_____**PAGES**_____

PROPOSED SUBSTITUTION_____

Please attach additional product information to form so that a complete comparison between the specified item and the substitution item can be thoroughly examined. Highlight and mark pages and items to be considered.

PRODUCT ANALYSIS:

SPECIFIED ITEM DESCRIPTION:	**SUBSTITUTION ITEM DESCRIPTION:**

For Architect/Engineer Use:

THE PROPOSED SUBSTITUTION IS ☐ APPROVED ☐ NOT APPROVED DATE_____

REMARKS_____

_____

307.265.3611 307.265.3617 fax 444 South Center Street Casper, WY 82601 www.stateline7.com

BID BOND

AIA DOCUMENT A310

AVAILABLE FROM THE ARCHITECT
(OR FROM THE AMERICAN INSTITUTE OF ARCHITECTS)

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

AIA DOCUMENT A101

AVAILABLE FROM THE ARCHITECT
(OR FROM THE AMERICAN INSTITUTE OF ARCHITECTS)

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

AIA DOCUMENT A201

AVAILABLE FROM THE ARCHITECT
(OR FROM THE AMERICAN INSTITUTE OF ARCHITECTS)

SUPPLEMENTAL GENERAL CONDITIONS
(to AIA A201 GENERAL CONDITIONS TO THE CONTRACT FOR CONSTRUCTION)

ARTICLE 1 – GENERAL PROVISIONS

1.1.1 THE CONTRACT DOCUMENTS *(Delete the last sentence and add the following:)*

Bidding Documents include but are not limited to advertisement or invitation to bid, Instructions to Bidders, the Contractor's Bid, and addenda or portions of addenda relating to any bidding documents.

(Add the following:)

1.1.9 NOT IN CONTRACT (N.I.C.)

All items indicated "N.I.C." (Not in Contract) on the Drawings or in the Specifications are items either furnished, installed and connected by the Owner, or excluded from the Contract.

(Add the following:)

1.1.10 OWNER FURNISH CONTRACTOR INSTALL (O.F.C.I.)

All items indicated "O.F.C.I." (Owner Furnished Contractor Install) on the Drawings or in the Specifications are to be furnished by the Owner and unloaded by the Contractor at the site in a location as directed by the Contractor. The Contractor shall move such items to the location of use in the building. The installation and/or service connections of this equipment shall be the responsibility of the Contractor as set forth in the Specifications and Drawings.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

(Add the following:)

1.2.1.2 In the event of conflicting provisions among the Contract Documents that were not called to the Architect's attention prior to award of the Contract, the Architect shall determine which of the conflicting requirements shall govern, generally taking as a guideline the more stringent requirement or more expensive material, unless, in the opinion of the Architect, another requirement is more appropriate. The Architect's decision shall be final in such case, and the Architect's decision shall not be further reviewable by arbitration or by litigation.

ARTICLE 3 – CONTRACTOR

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.1 *(Add the following:)*

The Contractor shall engage workers who are skilled in performing the Work, and all Work shall be performed with care and skill and in a good workmanlike manner under the full-time supervision of an approved foreman. The Contractor shall be liable for all property damage, including repairs and replacements of the Work and economic losses, which proximately result from the breach of this duty. The Contractor shall advise the Architect:

a) If a specified product deviates from good construction practices;

b) If following the Drawings and/or Specifications will affect any warranties; or

c) any objections which the Contractor may have to the Specifications.

Nothing contained in Subparagraph 1.1.3 shall alter the responsibilities established in this Subparagraph.

(Add the following:)

3.3.4 Immediately upon commencement of the Work, the Contractor shall retain the services of a licensed surveyor to verify the boundaries of the site and establish benchmarks for the Work. All discrepancies shall be immediately brought to the attention of the Architect.

3.6 TAXES

3.6 (Add the following to the end of the paragraph:)

…….. including but not limited to all sales taxes, use taxes, occupational taxes, excise taxes, Social Security benefits, unemployment compensation taxes, or similar levies on all materials, labor, tools, and equipment furnished under this Agreement, as required by the statutes of the state of Wyoming.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULE

3.10.1 (Add the following paragraph:)

The Owner's or Architect's silence as to a submitted schedule that exceeds time limits current under the Contract Documents shall not relieve the Contractor of its obligation to meet those time limits, nor shall it make the Owner or Architect liable for any of Contractor's damages incurred as a result of increased construction time or not meeting those time limits. Similarly, the Owner's or Architect's silence as to a Contractor's schedule showing performance in advance of such time limits shall not create or infer any rights in favor of the Contractor for performance in advance of such time limits.

*3.10.2 (**Delete** the word **"approval"** and **substitute** the word **"review"** and add the following to the end of the paragraph:)*

Neither the Contractor's preparation nor the Architect's receipt or review shall modify the Contractor's responsibility to make required submittals or to do so in a timely manner to provide for review in accordance with paragraph 4.2.7 as modified herein.

(Add:)

3.10.2.1. The schedule of submittals shall be submitted along with the construction schedule.

3.15 CLEANING UP

3.15.1 (Delete and replace with the following:)

The Contractor shall keep the site of the Work and adjacent premises as free from material, debris, and rubbish as is practicable, and shall remove same from any portion of the site, if, in the opinion of the Owner's representative such material, debris, or rubbish constitutes a nuisance or is objectionable in any way to the Owner. The Contractor further agrees to remove all machinery, materials, implements, barricades, staging, falsework, debris, and rubbish connected with or caused by the Work immediately upon the completion of the Work, and to clean all structures and work under the Contract Documents to the satisfaction of the Owner's representative, and to leave the premises in perfect condition insofar as affected by the Work hereunder. The Contractor shall be liable for all costs, liability, and expense, including but not limited to court costs, for all claims related to the control of dust.

(Add:)

3.15.3 At the completion of the Work and before acceptance and final payment, the Contractor shall restore and replace in a suitable manner all public and private site property which has been damaged or removed in the performance of this Contract. Site property includes portions of any and all structures, and adjacent portions of any streets, alleys, lawns, sidewalks, paving or property used in executing the Work.

ARTICLE 9 – PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

(Add:)

9.2.2 The Contractor shall submit to the Architect a breakdown of the Contract price within 15 days after issuance of a Notice to Proceed. Refer to the General Conditions, Article 9.2., as modified herein.

The prices shown on the schedule will be used for determining the basis of partial payments and will not be used for pricing changes in the Work.

The Schedule of Values shall be a detailed breakdown on a form provided by the Contractor. If the Schedule is submitted without sufficient detail, the Architect will request additional information and withhold approval of partial payments until complete price data is received. Omission by the Contractor of any item, device, equipment or part shall not relieve the Contractor from furnishing same when required by the Contract Documents.

The minimum information for the Schedule of Values shall be a listing of each section of each Division along with major sections of the particular division. Each unit of Work shall show one price and that price shall include labor, material, profit, overhead, temporary facilities, labor benefits, permits and fees, taxes, testing and miscellaneous. Bonds and insurance shall not be included in the "Unit of Work" price shall be listed separately as Items 1 and 2 of the price schedule.

9.3 APPLICATION FOR PAYMENT

9.3.1 *(Add the following:)*

The Contractor shall furnish the Owner, with each Application for Payment, a notarized Contractor's affidavit in a form satisfactory to the Owner's title company, along with proper waivers of lien and other supporting documentation sufficient to satisfy said title company that payment is properly due the Contractor.

(Add:)

9.3.1.3 The Architect will authorize ninety percent (90%) of the amount due the Contractor on account of progress so long as there are no outstanding liens or claims and so long as in the opinion of the Owner the previous work has been done properly and is on schedule for completion of the construction and the unpaid balance is sufficient to complete the unfinished work. No interest shall be paid on retention amounts.

9.8 SUBSTANTIAL COMPLETION

9.8.1 *(Delete and replace with the following:)*

Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof (which the Owner agrees to accept separately) is sufficiently complete in accordance with the Contract Documents so the Owner can legally and practicably occupy and utilize the Work for its intended use.

(Add:)

9.8.1.1 The Work will not be considered suitable for Substantial Completion review until all Project systems included in the Work are operational as designed and scheduled, all designated or required governmental inspections and certifications, including certificates of occupancy, have been made and posted, designated instruction of the Owner's personnel in the operation of systems has been completed, and all final finishes within the Contract Documents are in place. In general, the only remaining Work shall be minor in nature, so that the Owner or Owner's tenants could occupy the building and site on the date and the completion of the Work by the Contractor would not materially interfere with or hamper the normal business operations of the Owner or Owner's tenants (or those who claim by, through, or under Owner). As a further condition of Substantial Completion

acceptance, the Contractor shall certify that all remaining Work will be completed within thirty (30) consecutive calendar days or as agreed upon following the Date of Substantial Completion.

9.8.2 (Add the following:)

The Architect will make only two (2) such inspections to determine substantial completion. If these inspections determine that the work is not substantially complete, either because of major items not completed or an excessive number of punchlist items, successive inspections requested by the Contractors shall be charged to the Contractor at a rate of $ 1,000.00 per person per day (to be withheld from contractor's payment).

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.1 *(Add the following:)*

The Architect will make only two (2) such inspections to determine final completion. If these inspections determine that the Work is not finally complete, successive inspections requested by the Contractor shall be charged to the Contractor at a rate of $500.00 per person per day (to be withheld from the contractor's payment).

ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.7 *(Delete and substitute the following:)*

All parts of the Work shall be braced to resist wind or other loads. The Contractor shall perform the Work with the explicit understanding that the design of the Project is based on all parts of the Work having been completed and as such, the methods of performance of each part of the Work shall be done accordingly and entirely at the Contractor's choice.

(Add:)

10.2.8.1 Temporary items such as, but not limited to; scaffolding, staging, lifting and hoisting devices, shoring, excavation barricades, and safety and construction procedures necessary in completion of the Project shall be the responsibility of the Contractor and his subcontractors and shall comply with all applicable codes and regulations. OSHA Standards covering the construction industry shall be complied with in every respect. It shall not be the responsibility of the Owner or the Architect to determine if the Contractor, subcontractors or their representatives are in compliance with the aforementioned regulations.

ARTICLE 11 – INSURANCE AND BONDS

11.1CONTRACTOR'S INSURANCE AND BONDS

11.1.2 *(Delete and substitute the following:)*

The Contractor shall pay for and furnish a Performance Bond and Labor and Material Payment Bond, each in the amount equal to 100% of each Contract sum. Such bonds are to be executed on the AIA Forms enclosed by a corporate surety company licensed by the State of Wyoming to issue such bonds, and acceptable at the sole option of the Owner. Bonds shall remain in force throughout the warranty period; that is, one year beyond final completion.

END OF SUPPLEMENTAL GENERAL CONDITIONS

PERFORMANCE BOND

AIA DOCUMENT A312

AVAILABLE FROM THE ARCHITECT
(OR FROM THE AMERICAN INSTITUTE OF ARCHITECTS)

LABOR AND MATERIAL PAYMENT BOND

AIA DOCUMENT A312

AVAILABLE FROM THE ARCHITECT
(OR FROM THE AMERICAN INSTITUTE OF ARCHITECTS)

DIVISION

1

GENERAL REQUIREMENTS

SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Trona Valley Federal Credit Union

B. Architect's Name: Stateline No.7 Architects.

C. The Project consists of the alteration of three floor levels of new construction including drilled pier foundations with steel post-and-beam structure with structural floors and steel joists and concrete deck construction. The new building area includes approximately 29,481 gross square feet.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in the contract with the State of Wyoming.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. The work includes exerior sitework; exterior concrete flatwork, paving, retaining walls, and landscaping; cast-in-place concrete; masonry (stone); steel framing; misc. steel; wood doors and hollow metal frames; aluminum storefront windows; batt and rigid insulation; wood and metal framing; interior finish carpentry; metal panel siding; membrane roofing; wood ceilings and soffits; acoustical grid ceilings; a traction elevator; interior and exteriro painting and stain; gypsum board; rubber base; carpet; sheet viny; porcelain floor ana wall tile; toilet partitions and toilet accessories; quartz counterops; granite countertops; solid surface countertops; plastic laminate countertops; plumbing and plumbing fixtures; fire protections system; HVAC equpments; fire alarm system; electrical widring and interior and exterior light fixtures; and other miscllaneous items.

1.04 WORK BY OWNER

A. The owner will supply and install equipment as noted on the drawings.

1.05 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Arrange use of site and premises to allow:
   1. Work by Others.

C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered. See sequencing plan on drawings for additional information.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement (or similar form).

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Monthly.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Include the following with the application:
   1. Partial release of liens from major subcontractors and vendors as stipulated in the Owner-Contractor agreement.
   2. Affidavits attesting to off-site stored products.

J. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.05 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 10 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 016000.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. Provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
   3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 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.

1.03 SCHEDULE OF ALTERNATES

A. Vehicle Canopy Alternate: Provide for a pre-engineered metal building vehicle canopy shelter complete as shown on the landscape plans.

B. Drop-Off Shelter Alternate: Provide for a pre-engineered metal building drop-off shelter complete as shown on the landscape plans.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 012300 - Alternates, for product alternatives affecting this section.

B. Section 013000 - Administrative Requirements: Submittal procedures, coordination.

C. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered after the bid period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.
   2. Use the product substitution request form included in the project manual.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
   2. Owner and the design team will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

B. Submittal Form (before award of contract):
   1. Submit substitution requests by completing the form contained in the project manual. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable (including standard susbstition forms from suppliers and subcontractors).

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

B. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

C. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Web-based project software service.

C. Electronic document submittal service.

D. Preconstruction meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Submittals for review, information, and project closeout.

H. Requests for Interpretation (RFI) procedures.

I. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: General product requirements.

B. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WEB-BASED PROJECT SOFTWARE SERVICE

A. Web-Based Project Software Service is not required, but may be used.
   1. Web-Based Project Software Service
      a. Web-Based Project Software Service: Provide, administer, and use web-based project software to host and manage project communication and documentation.
         1) Include the following features:
            (a) Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
            (b) Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.

(c) _____.

2) Cost: Pay cost of service. Include the cost of the service in the contract sum.
3) Comply with the software service's current published licensing agreements.
4) Web-Based Project Software Services: The selected service is:

2. ELECTRONIC DOCUMENT SUBMITTAL SERVICE
   a. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, as appropriate to the document, and transmitted via email or alternatively an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
      1) Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
      2) It is Contractor's responsibility to submit documents in allowable format.
      3) If an alternate internet based submittal service is used, subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
      4) Paper document transmittals will not be reviewed.
      5) All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
      6) Any verification samples or samples for selection must be accompanied by the physical sample (no photographs and/or brochure color selections or verifications will be made).
   b. Cost: The cost of the alternate internet based submittal service, if used, is to be paid by Contractor; include the cost of the service in the Contract Sum.
3. PRECONSTRUCTION MEETING
   a. Architect will schedule a meeting after Notice of Award, if necessary.
   b. Attendance Required:
      1) Owner.
      2) Architect and necessary Design Team Consultants.
      3) Contractor.
      4) Major Subcontractors (sitework, mechanical, electrical, plumbing, etc..
   c. Items to be submitted to the Architect prior to preconstruction meeting:
      1) Execution of Owner-Contractor Agreement or change order for the portion of the work (Building Package).
      2) Submission of executed insurance certificates.
      3) Submission of list of subcontractors, schedule of values, and progress schedule.
      4) Designation of personnel representing the parties to Contract and Architect.
      5) Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
      6) Scheduling.
4. PROGRESS MEETINGS
   a. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
   b. Attendance Required:
      1) Contractor.
      2) Owner.
      3) Architect.
      4) Special consultants when necessary.

5) Contractor's superintendent and project coordinator/manager.
6) Major subcontractors when necessary.

c. Agenda:
1) Review of work progress.
2) Field observations, problems, and decisions.
3) Identification of problems that impede, or will impede, planned progress.
4) Review of submittals schedule and status of submittals.
5) Review of RFIs log and status of responses.
6) Review of off-site fabrication and delivery schedules.
7) Maintenance of progress schedule.
8) Corrective measures to regain projected schedules.
9) Planned progress during succeeding work period.
10) Coordination of projected progress.
11) Maintenance of quality and work standards.
12) Effect of proposed changes on progress schedule and coordination.
13) Other business relating to work.

5. CONSTRUCTION PROGRESS SCHEDULE
a. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
b. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
c. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1) Ensure that major Subcontractors have reviewed and accepted proposed schedule prior to submittal.
d. Within 10 days after joint review, submit complete schedule.
e. Submit updated schedule every 30 days.

6. REQUESTS FOR INTERPRETATION (RFI)
a. Definition: A request seeking one of the following:
1) An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2) A resolution to an issue which has arisen due to field conditions and affects design intent.
b. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1) Prepare a separate RFI for each specific item.
(a) Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
(b) Do not forward requests which solely require internal coordination between subcontractors.
2) Prepare using an electronic version of the form appended to this section.
3) Combine RFI and its attachments into a single electronic file. PDF format is preferred.
c. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1) Unacceptable Uses for RFIs: Do not use RFIs to request the following::
(a) Approval of submittals (use procedures specified elsewhere in this section).
(b) Approval of substitutions (see Section - 016000 - Product Requirements)

(c) Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
(d) Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

2) Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
(a) The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

d. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1) Official Project name and number, and any additional required identifiers established in Contract Documents.
2) Discrete and consecutive RFI number, and descriptive subject/title.
3) Issue date, and requested reply date.
4) Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
5) Annotations: Field dimensions and/or description of conditions which have engendered the request.
6) Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

e. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

f. Review Time: Architect will respond and return RFIs to Contractor within ten calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.

g. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1) Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R, R1, R2, etc. suffix to the original number.
2) Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3) Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4) Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

7. SUBMITTALS FOR REVIEW
a. When the following are specified in individual sections, submit them for review:
1) Product data.
2) Design data.

3) Shop drawings.
4) Samples for selection.
5) Samples for verification.

b. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
c. Contractor to review (thoroughly) all submittals prior to forwarding to the Architect.
d. Samples will be reviewed for aesthetic, color, or finish selection.
e. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

8. SUBMITTALS FOR INFORMATION
   a. When the following are specified in individual sections, submit them for information:
      1) Design data.
      2) Certificates.
      3) Test reports.
      4) Inspection reports.
      5) Manufacturer's instructions.
      6) Manufacturer's field reports.
      7) Other types indicated.
   b. Submit for Architect's knowledge as contract administrator or for Owner.
9. SUBMITTALS FOR PROJECT CLOSEOUT
   a. Submit Correction Punch List for Substantial Completion.
   b. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
      1) Project record documents.
      2) Operation and maintenance data.
      3) Warranties.
      4) Bonds.
      5) Other types as indicated.
   c. Submit for Owner's benefit during and after project completion.
10. NUMBER OF COPIES OF SUBMITTALS
    a. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
    b. Samples (hard copies of colors/materials to be selected): Submit the number specified in individual specification sections; two of which will be retained by Architect.
       1) After review, produce duplicates.
       2) Retained samples will not be returned to Contractor unless specifically so stated.
       3) Contractor responsible for all costs associated with procuring and providing samples.
11. SUBMITTAL PROCEDURES
    a. General Requirements:
       1) Use a separate transmittal for each item.
       2) Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
       3) Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
       4) Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.

(a) Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.

5) Deliver submittals to Architect at business address or email electronic/PDF submittals.

6) Schedule submittals to expedite the Project, and coordinate submission of related items.

(a) For each submittal for review, allow 10 days excluding delivery time to and from the Contractor.

7) Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.

8) Provide space for Contractor and Architect review stamps.

9) When revised for resubmission, identify all changes made since previous submission.

10) Distribute reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

11) Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

12) Submittals not requested will not be recognized or processed.

13) Submittals not requested will be recognized, and will be returned "Not Reviewed",

b. Product Data Procedures:

1) Submit only information required by individual specification sections.

2) Collect required information into a single submittal.

3) Do not submit (Material) Safety Data Sheets for materials or products.

c. Shop Drawing Procedures:

1) Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.

2) Do not reproduce Contract Documents to create shop drawings.

3) Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

d. Samples Procedures:

1) Transmit related items together as single package.

2) Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

12. SUBMITTAL REVIEW

a. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

b. Submittals for Information: Architect will not acknowledge receipt, and take no other action.

c. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

1) Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

d. Architect's and consultants' actions on items submitted for review:

1) Authorizing purchasing, fabrication, delivery, and installation:

(a) "Approved", or language with same legal meaning.

(b) "Approved as Noted, Resubmission not required", or language with same legal meaning.

(c) "Approved as Noted, Resubmit for Record", or language with same legal meaning.

(1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.

(2) Non-responsive resubmittals may be rejected.

2) Not Authorizing fabrication, delivery, and installation:
   (a) "Revise and Resubmit".
      (1) Resubmit revised item, with review notations acknowledged and incorporated.
      (2) Non-responsive resubmittals may be rejected.
   (b) "Rejected".
      (1) Submit item complying with requirements of Contract Documents.

e. Architect's and consultants' actions on items submitted for information:
   1) Items for which no action was taken:
      (a) "Received" - to notify the Contractor that the submittal has been received for record only.
   2) Items for which action was taken:
      (a) "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 013553
SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security measures including entry control, personnel identification, and miscellaneous restrictions.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: use of premises and occupancy.

B. Section 015000 - Temporary Facilities and Controls: Temporary lighting.

1.03 SECURITY PROGRAM

A. Protect Work , existing premises and Owner's operations from theft, vandalism, and unauthorized entry.

B. Initiate program at project mobilization.

C. Maintain program throughout construction period until Owner occupancy.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into Project site .

B. Allow entrance only to authorized persons with proper identification.

C. Maintain log of workers and visitors, make available to Owner on request.

1.05 RESTRICTIONS

A. Do not allow cameras on site or photographs taken except by written approval of the Contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Control of installation.

G. Mock-ups.

H. Tolerances.

I. Manufacturers' field services.

J. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittal procedures.

B. Section 016000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Design Services Types Required:
      a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
      b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include required product data and shop drawings.
   2. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   3. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Test Reports: After each test/inspection, promptly submit electronic copies of report to Architect, Owner, and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.

2. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.08 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

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

E. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

C. Contractor is responsible for coordinating and scheduling of materials testing agency.

D. Costs for re-testing due to failure to meet specifications shall be borne by the General Contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
   1. Coordinate timing of mock ups to coincide with regular Owner-Architect-Contractor meetings.

D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

F. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

G. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

H. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.

3. Provide incidental labor and facilities:
    a. To provide access to Work to be tested/inspected.
    b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    c. To facilitate tests/inspections.
    d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 014219
REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.

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

D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AA -- ALUMINUM ASSOCIATION, INC.

A. AA DAF-45 - Designation System for Aluminum Finishes; 2003 (Reaffirmed 2009).

2.02 AABC -- ASSOCIATED AIR BALANCE COUNCIL

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).

B. AAMA 305 - Voluntary Specification for Fiber Reinforced Thermoset Profiles; 2022.

C. AAMA 307 - Voluntary Specification for Laminates Intended for Use on AAMA Certified Profiles; 2016.

D. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.

E. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

F. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

G. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.

H. AAMA 624 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Fiber Reinforced Thermoset Profiles; 2020.

I. AAMA SFM-1 - Aluminum Storefront and Entrance Manual; 2014.

2.04 AATCC -- AMERICAN ASSOCIATION OF TEXTILE CHEMISTS & COLORISTS

2.05 ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Concrete Construction; 2020.

C. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

E. ACI 305R - Guide to Hot Weather Concreting; 2020.

F. ACI 306R - Guide to Cold Weather Concreting; 2016.

G. ACI 308R - Guide to External Curing of Concrete; 2016.

H. ACI 310.1 - Specification for Polished Concrete Slab Finishes; 2020.

2.06 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

A. AIA G702 - Application and Certificate for Payment; 1992.

B. AIA G702CMa - Application and Certificate for Payment, Construction Manager-Adviser Edition; 1992.

2.07 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

A. AISC 325 - Steel Construction Manual; 2023.

2.08 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

A. ANSI/ACMA (GM) - FRP Composites Grating Manual for Pultruded and Molded Grating and Stair Treads; 2017.

B. ANSI/APA PRG 320 - Standard for Performance-Rated Cross-Laminated Timber; 2019.

C. ANSI/AWI 0400 - Factory Finishing; 2022.

D. ANSI/AWI 0620 - Finish Carpentry/Installation; 2018.

E. ANSI/AWI 0641 - Architectural Wood Casework; 2019.

F. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.

G. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

H. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

I. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

J. 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.

K. 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.

L. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.

M. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.

N. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

O. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.; 2003.

P. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.; 1998 (R2011).

Q. ANSI A250.11 - Recommended Erection Instructions for Steel Frames.; 2012.

R. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

S. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

T. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

U. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2022.

V. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction); 2019.

W. ANSI A300 Part 6 - Tree, Shrub, and Other Woody Plant Management--Standard Practices (Planting and Transplanting); 2012 (Reapproved 2018).

X. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

2.09 APA -- APA - THE ENGINEERED WOOD ASSOCIATION

A. APA E30 - Engineered Wood Construction Guide; 2019.

B. APA PRP-108 - Performance Standards and Qualification Policy for Wood Structural Panels (Form E445); 2021.

2.10 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASHRAE (REFR) - ASHRAE Handbook - Refrigeration; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASHRAE (HVACS) - ASHRAE Handbook - HVAC Systems and Equipment; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

2.11 ASTM A SERIES -- ASTM INTERNATIONAL

A. ASTM A29/A29M - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought; 2023.

2.12 ASTM D SERIES -- ASTM INTERNATIONAL

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

2.13 AWC -- AMERICAN WOOD COUNCIL

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

2.14 DHI -- DOOR AND HARDWARE INSTITUTE

A. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

B. DHI (KSN) - Keying Systems and Nomenclature; 2019.

C. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; 2000 (ANSI/DHI A115 Series).

2.15 FM -- FACTORY MUTUAL GLOBAL

A. FM (AG) - FM Approval Guide; Current Edition.

2.16 GA -- GYPSUM ASSOCIATION

A. GA-201 - Using Gypsum Board for Walls & Ceilings; 1990.

B. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board;.

C. GA-214 - Levels of Finish for Gypsum Panel Products; 2021.

2.17 HPVA -- HARDWOOD PLYWOOD VENEER ASSOCIATION

A. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.

2.18 ICC -- INTERNATIONAL CODE COUNCIL, INC.

A. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

B. ICC (IEBC) - International Existing Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

2.19 IGMA -- INSULATING GLASS MANUFACTURERS ALLIANCE

A. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

B. IGMA TM-4000 - Insulating Glass Manufacturing Quality Procedures; 2002 (Reaffirmed 2007).

2.20 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

A. NFPA 1 - Fire Code; 2024, with Errata.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

2.21 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION

A. NRCA (RM) - The NRCA Roofing Manual; 2025.

2.22 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

A. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

2.23 UL -- UNDERWRITERS LABORATORIES INC.

A. UL (BMD) - Building Materials Directory; current edition.

B. UL (DIR) - Online Certifications Directory; Current Edition.

C. UL (FRD) - Fire Resistance Directory; Current Edition.

2.24 WCMA -- WINDOW COVERING MANUFACTURERS ASSOCIATION

A. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Temporary Controls: Barriers, enclosures, and fencing.

E. Security requirements.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Project identification sign.

I. Field offices.

1.02 TEMPORARY UTILITIES

A. Contractor to provide the following and include in the project costs:
   1. Electrical power, consisting of making these available..
   2. Water supply, consisting of making these available.

B. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office and/or superintendent at time of project mobilization.

B. Provide equivalent equipment and connections for Owner's field office.

C. Telecommunications services shall include:
   1. Cellular telephone access to all on-site project personnel.
   2. Internet Connections: Minimum of one; DSL modem or faster.
   3. Email: Account/address reserved for project use for all on-site and off-site project personnel.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide protection for plants and site features (rock outcroppings) designated to remain. Replace damaged plants.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 SECURITY

A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft.

1.09 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Provide temporary parking areas in fenced construction areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

F. Use on-street parking as allowed by the City may be used to accommodate construction personnel.

1.10 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner permission except those required by law.

1.12 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 10 persons.

C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

E. Procedures for Owner-supplied products.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Identification of Owner-supplied products.

B. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

C. Section 014000 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.04 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:

1. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

B. "Notice for Request for Bids" document specifies time restrictions for submitting requests for substitutions during the bidding period and the documents required.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

D. A Substitution Request for products, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

E. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

F. Substitution Submittal Procedure:
   1. Prior to bid date, submit request for substitution using standard product substitution form contained in this project manual (see due date on form).
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.

4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
   1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

J. Comply with manufacturer's warranty conditions, if any.

K. Do not store products directly on the ground.

L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

M. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

N. Prevent contact with material that may cause corrosion, discoloration, or staining.

O. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

P. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures.

B. Section 014000 - Quality Requirements: Testing and inspection procedures.

C. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.

D. Section 015100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.

E. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

F. Section 078400 - Firestopping.

G. Individual Product Specification Sections:

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Alternatives to cutting and patching.
      f. Effect on work of Owner or separate Contractor.
      g. Written permission of affected separate Contractor.
      h. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.

F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.

H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

I. Ensure windows, doors, and the buildign envelope remains closed and sealed to prevent the intrusion of bats, rodents and insects.

J. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

K. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 011000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

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

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Contractor to prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

G. Utilize recognized engineering survey practices.

H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

I. Periodically verify layouts by same means.

J. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 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 alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction as needed .

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.

D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

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

F. Restore work with new products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

I. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from completed landscaped areas.

I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Testing, adjusting and balancing HVAC systems: See the Mechanical Specifications Divisions.

3.13 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion and Architect's punch walkthrough before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from area drains and drainage systems.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

J. Clean Owner-occupied areas of work that were affected by construction activities.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

D. Owner will occupy all of the building as specified in Section 011000.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect prior to claim for final payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents (physical copy); record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record information for "as-built" drawings concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers (typed) of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
   1. Include HVAC outdoor and exhaust air damper calibration strategy.

a. Include provisions which ensure that full closure of dampers can be achieved.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Provide control diagrams by controls manufacturer as installed.

J. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

L. Include test and balancing reports.

M. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into PDF digital format for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

D. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor subcontractors and major material suppliers, with names of responsible parties.

E. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

F. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

G. Text: Manufacturer's printed data.

H. Drawings.

I. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Original warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Manual: PDF digital format in one single file and tabbed dividers.

END OF SECTION

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. Plumbing equipment.
   3. Electrical systems and equipment.
   4. Conveying systems.
   5. Landscape irrigation.
   6. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than prior to start prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide _____ of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.
   2. Label each disc and container with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Provide training in minimum two hour segments.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.

10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

DIVISION

3

CONCRETE

SECTION 033000
CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings and Foundation walls.
   2. Slabs-on-grade and slabs on steel deck.

B. Related Sections include the following:
   1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement and Type-F Fly Ash.

1.4 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

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

D. Welding certificates.

E. Qualification Data: For Installer manufacturer testing agency.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

G. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Fiber reinforcement.
   6. Curing compounds.
   7. Floor and slab treatments.
   8. Bonding agents.
   9. Adhesives.
   10. Semirigid joint filler.
   11. Joint-filler strips.
   12. Repair materials.

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

I. Field quality-control test and inspection reports.

J. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

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

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

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

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

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

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

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Floor polishing subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
C. Plain-Steel Wire: ASTM A 82, as drawn galvanized.
D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type IL.
2. Fly Ash: ASTM C618 Type-F.
B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.
B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
1. Available Products:

a. Monofilament Fibers:
1) Axim Concrete Technologies; Fibrasol IIP.
2) Euclid Chemical Company (The); Fiberstrand 100.
3) FORTA Corporation; Forta Mono.
4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth.

2.8 FLOOR AND SLAB TREATMENTS

A. Floor Sealer: "Day-Chem Sure Hard" (J-17) by Dayton Superior or approved equal. Product shall be compatible with previous product used for curing.

2.9 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Curing Compound: (ACI 301 5.3.6.4.e) For floors scheduled to receive floor finishes, use only product that conforms to ASTM C1315. For floors that are to be exposed to view and will not receive floor finishes, use product that conforms to ASTM C309, Type I-D, Class B, 18% solids content minimum, and has test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon (2 coats minimum). Manufacturers certification required.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
1. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows: Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Waterstops: Waterstops shall be a specifically formulated compound of bentonite/butyl that swells upon contact with water: Waterstop RX 101 by "CETCO" or approved equal.

D. Under-Slab Vapor Barrier: Provide water vapor barrier cover over prepared base material where indicated below slabs on grade. Barrier material shall be a plastic membrane of not less than 10 mils thick and shall meet or exceed the following requirements: Maximum WVTR of 0.008 as tested by ASTM E96. Meets or exceeds ASTM E-1745, Class A.

E. Approved Vapor Barrier Products: Stego Wrap (15mil) vapor barrier by Stego Industries LLC. Premoulded Membrane with Plastimatic Core by W.R. Meadows. VaporGuard by Reef Industries. Zero-Perm by Alumiseal. Seam Tape: High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches. Pipe Boots: Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Portland Cement and Type-F Fly Ash only.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. All Structural Concrete:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 4 inches 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch. Concrete for drilled piers is required to have min 6" slump, Max. 8" slump.
   4. Minimum Cement Content = 600 lbs / Cubic Yard.
   5. Maximum 15% Fly Ash by weight of total cementitious materials.
   6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch 3/4-inch nominal maximum aggregate size.

B. Slabs on grade and slabs on steel deck (smooth troweled finish only): Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 3500 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: 4 inches 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch. Concrete for drilled piers is required to have min 6” slump, Max. 8” slump.
   4. Minimum Cement Content = 517 lbs / Cubic Yard, maximum = 564 lbs / Cubic Yard.
   5. Maximum 15% Fly Ash by weight of total cementitious materials.
   6. Air Content: 3 percent maximum for slabs to receive a smooth trowelled finish.

C. See respective specification sections for concrete mix designs at splash pad and ice rink.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

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

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

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class B, 1/4 inch <Insert dimension> for rough-formed finished surfaces.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

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

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

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

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

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

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

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Coordinate installation of reinforcing steel with installation of radiant heat tubing. Heat tubing to be placed on reinforcing steel mat and securely tied in place to every intersection bar.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved100 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

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

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

3.4 STEEL REINFORCEMENT

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

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

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4, where indicated.

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

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

3.5 JOINTS

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

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

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
   2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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

3.6 CONCRETE PLACEMENT

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

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

E. See construction documents for detailing at construction joints and column blockouts. It is critical that the ready mix concrete mix is uniform when slabs and column blockout infill is cast. It is critical that the joints at these blockouts are flush and clean, and that both the slab and the blockout infill are cast over the footing or pilaster below.

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

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

G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

3.8 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch

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

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

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

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

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings and for all pumps, boilers, tanks, fans, transformers, floor mounted electrical equipment, etc. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment. Finish all bases in a workmanlike manner with trowelled finish. The bases shall be located and sizes determined by the contractor furnishing the equipment.

D. Splash Blocks: Install precast concrete splash blocks under all downspouts or roof drain leaders emptying onto unpaved areas.

E. Anchors: Install anchors furnished under section 05500 in accordance with Shop Drawings for structural or miscellaneous steel.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

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

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

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

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

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. -fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 FLOOR SEALER

A. Apply specified sealing compound to all slabs on grade not scheduled to receive further finish (Re: Room Finish Schedule), following completion of ten day moisture cure, in accordance with manufacturer’s recommendations. Apply specified sealing compound to other areas as indicated on the drawings.

3.12 JOINT FILLING

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

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

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

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

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.

4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

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

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.15 Vapor Barrier Placement:

A. Underslab surfaces shall be fine graded smooth, level surface prior to installation of slab on grade edge and construction forms. Compact and level subbase material to the following tolerances +0 in., –3/4 in. Install vapor barrier in accordance with the manufacturer's instructions and ASTM E 1643-98: Unroll vapor barrier with the longest dimension parallel with the direction of the pour. Lap vapor barrier over foundation elements and seal to foundation walls. Overlap joints 6 inches and seal with manufacturer's tape. Seal all penetrations (including pipes) with manufacturer's pipe boot. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION 033000

DIVISION

4

MASONRY

SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firebox brick.

B. Mortar.

C. Reinforcement and anchorage.

D. Lintels.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: framing (and sheathing) to support refractory brick.

B. Section 103100 - Manufactured Fireplaced: log set and fireplace unit.

C. Mechanical Drawings and Specifications: Fireplace damper, flue, and other accessories.

1.03 REFERENCE STANDARDS

A. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

D. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick; 1998 (Reapproved 2022).

E. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars; 2022.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Samples: Submit one samples of standard colors of refractory brick units to illustrate color, texture, and extremes of color range to select from.

D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 BRICK UNITS

A. Fireclay Refractory Brick: ASTM C27 Class High-duty; nominal size to suit application.

2.02 MORTAR MATERIALS

A. Refractory Mortar: Provide hydraulic-setting or premixed high-alumina refractory mortar containing calcium aluminate cements, ground fire clay, ganister, etc. and complying with ASTM C199.

2.03 REINFORCEMENT AND ANCHORAGE

A. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.

B. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.

2.04 LINTELS

A. Prefabricated Steel Lintels:
   1. Manufacturers:
      a. Substitutions: See Section 016000 - Product Requirements.

B. Brickwork Support System: Offset steel relief angles or lintels with hanger brackets for support of brickwork above horizontal masonry joints and openings to allow insulation to span continuously behind brick and eliminate continuous thermal bridges associated with support systems that interrupt continuous insulation.
   1. Sizes: Component and anchor sizes and spacing to be determined by manufacturer from calculations or prescriptive design tables to suit project loading conditions and cavity width indicated on drawings.
   2. Materials: Steel, hot dip galvanized to ASTM A153/A153M class B.
   3. Manufacturers:
      a. FERO Corporation; FERO FAST Thermal Bracket Offset Shelf Angle - STANDARD: www.ferocorp.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

2.05 MORTAR MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

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

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:
   1. Bond: Stacked.
   2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches (150 mm).

F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches (400 mm) on center.

G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.

3.06 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.

3.07 LINTELS

A. Install loose steel lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
   1. Openings from 42 inches (1070 mm) to 78 inches (1980 mm): Place two, No. 5 (M16) reinforcing bars 1 inch (25 mm) from bottom web.
   2. Openings over 78 inches (1980 mm): Reinforce openings as detailed.
   3. Do not splice reinforcing bars.
   4. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
   5. Place and consolidate grout fill without displacing reinforcing.
   6. Allow masonry lintels to attain specified strength before removing temporary supports.

C. Maintain minimum ____ inch (____ mm) bearing on each side of opening.

D. Install thermal brick support system in accordance with manufacturer's instructions at locations indicated on drawings

3.08 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.

D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

3.09 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.10 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.11 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 044313
STONE MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Accessories for adhered veneer.

B. Setting mortar.

1.02 RELATED REQUIREMENTS

A. Section 042000 - Unit Masonry: refractory brick.

1.03 REFERENCE STANDARDS

A. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006 (Reapproved 2024).

B. ASTM C1242 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems; 2022a.

C. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit six verification stone samples illustrating color range, texture, and markings.

1.05 QUALITY ASSURANCE

A. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum five years of documented experience.

1.06 MOCK-UP

A. Construct stone wall mock-up, three feet (____ m) long by three feet (____ m) wide; include stone anchor accessories and corner condition in mock-up.

B. See Section 014000 - Quality Requirements for additional requirements.

C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect stone from discoloration during storage on site.

B. Provide ventilation to prevent condensation from forming on stone.

1.08 FIELD CONDITIONS

A. Cold Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

B. Maintain materials and ambient air at minimum of 40 degrees F (5 degrees C) prior to, during, and for 48 hours after completion of work.

PART 2 PRODUCTS

2.01 STONE

A. Stone, as indicated on the drawings.

2.02 MORTAR APPLICATIONS

A. Field-mix all mortar.

B. Mortar Color: Natural gray unless otherwise indicated.

C. Setting Bed Mortars: Setting bed used to adhere stone veneer units to scratch coat mortar or to bondable concrete or concrete masonry.
   1. Prepackaged/Preblended: ASTM C1714/C1714M, Type S.

2.03 MORTAR MIXES

2.04 ACCESSORIES - ADHERED VENEER

A. Lath (mesh): type as recommended for application.

B. Bonding Compound: Provide type recommended for bonding scratch coat to solid surfaces, complying with ASTM C932.

C. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.05 STONE FABRICATION - ADHERED VENEER

A. Comply with ASTM C1242 requirements for adhered stone system without mechanical anchors for maximum stone weight and maximum individual stone panel size.

B. Comply with TMS 402/602 size requirements for adhered stone veneer units for maximum thickness, maximum face dimension, maximum face area and maximum weight per square foot.

C. Nominal Thickness: 3/4 inch to 1-1/4 inches (19 mm to 32 mm).

D. Length: 6 inches to 14 inches (152 mm to 356 mm).

E. Style: As indicated on drawings.

F. Style: Ledgestone.

G. Fabricate for 3/8 inch (10 mm) beds and joints.

H. Backs: Sawn.

I. Form stone corners to irregular joint profile. Clean jagged corners from stone in preparation for setting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.
   1. Per ASTM C1242, exterior walls to receive thin natural stone veneers should be designed with a stiffness ratio of L/1000 minimum.

B. Verify that substrates to receive mortar scratch coat or setting bed comply with stone veneer manufacturer's instructions.
   1. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

C. Verify that items built-in under other sections are properly located and sized.

3.02 PREPARATION - ANCHORED VENEER

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to installation. Do not use wire brushes or implements that mark or damage exposed surfaces.

C. Clean sawn surfaces of rust stains and iron particles.

D. Coat back surfaces not to be in contact with setting mortar with back coating material. Allow coating to cure.

3.03 PREPARATION - ADHERED VENEER

A. Dampen masonry surfaces to reduce excessive suction.

B. Clean concrete surfaces of foreign matter using approved acid solutions, solvents, or detergents, and then rinse surfaces thoroughly with clean water.

C. Apply dash bond coat to solid bases and moist cure for at least 24 hours before applying setting bed.

3.04 INSTALLATION - ADHERED VENEER

A. Install thin stone veneer with a cementitious mortar setting bed to a scratch coat backing surface, in accordance with stone fabricator's instructions and applicable sections of the ICC (IBC), TMS 402/602 and ASTM C1242 that apply to adhered masonry veneer.

B. Pattern Bond:
   1. Lay out work in advance and distribute color range of stone uniformly over total work area.
   2. Lay stone with face exposed.
   3. Take care to avoid concentration of any one color to any one wall surface.
   4. Maintain approximate 3/8 inch (10 mm) joint, as stone allows.
   5. Do not use stacked vertical joints.

3.05 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m) and 1/2 inch in 20 feet (13 mm in 6 m) or more.

D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm in 1 m) and 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 30 feet (13 mm in 9 m).

3.06 CLEANING

A. Remove excess mortar as work progresses, and upon completion of work.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.07 PROTECTION

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION

DIVISION

5

METALS

SECTION 051200
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Structural steel.

2. Architecturally exposed structural steel.
3. Grout.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
3. Division 9 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

B. Architecturally Exposed Structural Steel: Any structural steel framing members that are exposed to view in the completed project.

1.4 SUBMITTALS

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

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding certificates.

D. Qualification Data: For Installer fabricator testing agency.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shear stud connectors.
6. Shop primers.
7. Nonshrink grout.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer with a minimum of 10 years documented experience with projects of similar size and complexity.

B. Fabricator Qualifications: A qualified fabricator who has a minimum of 10 years documented experience with projects of this type, size and complexity.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
4. AISC's "Specification for Allowable Stress Design of Single-Angle Members "
5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

B. Contractor shall thoroughly survey existing construction prior to bidding to determine which items required by the plans have not yet been provided and/or installed. All items required by the plans that are not yet in place are part of this contract (furnish and install).

C. Contractor shall thoroughly clean all existing welds on all structural steel and steel joists and remove any corrosion. Welds shall be built back out to the size required by the plans.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 572/A 572M, Grade 50.

B. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: As indicated.
2. Finish: Black, except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Hooked.
2. Nuts: ASTM A 563 heavy hex carbon steel.

3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Plain.

E. Threaded Rods: ASTM A 307, Grade A.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Washers: ASTM F 436 hardened ASTM A 36/A 36M carbon steel.
3. Finish: Plain Mechanically deposited zinc coating, ASTM B 695, Class 50.

F. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

G. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A 780.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

5. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
6. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning SSPC-SP 2, "Hand Tool Cleaning SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Slip critical.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.
6. Surfaces to receive field welded anchor studs.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize Items denoted on the plans only.

2.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Architecturally exposed Structural Steel framing shall have all welds ground smooth and filled. No rough or unsightly connections will be permitted.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Slip critical.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
5. Dress welds on architecturally exposed structural steel per section 3.3-H.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.

b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Open-web, K-series steel joists.
2. KCS-type, open-web, K-series steel joists.
3. LH-series, long-span steel joists.
4. Steel Joist Bridging.

1.2 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.

C. Welding certificates.

D. Mill certificates.

E. Research/evaluation reports.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.

B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers; plain, uncoated.

C. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers; plain, uncoated.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.3 STEEL JOISTS

A. Manufacture steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members, and as follows:

1. Manufacture K-series KCS-type, steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
2. Manufacture LH-series steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series," with end and top-chord arrangements indicated.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

2.5 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."

C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.6 SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply 1 shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.

E. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

END OF SECTION 05210

SECTION 053100

STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Roof deck.
2. Composite form deck.

B. Related sections:

1. Section 033000 - Cast-in-Place Concrete: Concrete fill.
2. Section 051200 - Structural Steel Framing; Shop and field-welded shear connectors.
3. Section 055000 - Metal Fabrications; Framing deck openings with miscellaneous steel shapes.

1.2 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

G. Research/Evaluation Reports: For steel deck.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.5 COORDINATION

A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation specified in Division 07 Section " to ensure protection of insulation strips against damage from effects of weather and other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Steel Deck:

a. ASC Profiles, Inc.
b. Canam Steel Corp.;The Canam Manac Group.
c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.
h. New Millennium Building Systems, LLC.
i. Nucor Corp.; Vulcraft Division.
j. Roof Deck, Inc.
k. United Steel Deck, Inc.
l. Valley Joist; Division of EBSCO Industries, Inc.
m. Verco Manufacturing Co.

n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped.

2.3 COMPOSITE FORM DECK

A. Composite Steel Form Deck: Fabricate panels to comply with "SDI Specifications and Commentary for Composite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G60 zinc coating.
2. Profile Depth: 3 inches.
3. Design Uncoated-Steel Thickness: 22 Gage.
4. Span Condition: Triple span or more.
5. Shear studs shall be welded to floor purlins through the deck with an approved stud welding gun.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing: As indicated.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: As indicated.

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in Division 07 Section ".

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Space and locate welds as indicated.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 16 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Exterior / Interior non-load-bearing wall framing.
2. Ceiling joist framing.

B. Related sections:

1. Section 055000 - Metal Fabrications; Masonry shelf angles and connections.
2. Section 092216 – Non-structural Metal Framing; Interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
3. Section 092116.23 - Gypsum Board Shaft Wall Assemblies; Interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.2 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Welding certificates.

D. Qualification Data: For testing agency.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Mechanical fasteners.
3. Vertical deflection clips.
4. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.

1.3 QUALITY ASSURANCE

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

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Allied Studco.
2. AllSteel Products, Inc.
3. California Expanded Metal Products Company.
4. Clark Steel Framing.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.
9. Design Shapes in Steel.
10. Dietrich Metal Framing; a Worthington Industries Company.
11. Formetal Co. Inc. (The).
12. Innovative Steel Systems.
13. MarinoWare; a division of Ware Industries.
14. Quail Run Building Materials, Inc.
15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.

18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST50H.
2. Coating: G90 or equivalent.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING (INCLUDES STAIR SHAFTS)

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.
3. Section Properties: As indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dietrich Metal Framing; a Worthington Industries Company.
b. MarinoWare, a division of Ware Industries.
c. SCAFCO Corporation
d. The Steel Network, Inc.

2.4 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.
3. Section Properties: As indicated.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Connect vertical deflection clips to bypassing studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Loose bearing and leveling plates.
4. Steel weld plates and angles.
5. Miscellaneous steel trim.
6. Metal ladders.
7. Metal Ship's Ladder
8. Metal bollards.
9. Pipe guards.
10. Metal floor plate and supports.
11. Abrasive metal nosings.
12. Loose steel lintels.

B. Related sections:

1. Section 055100 – Metal Stairs.
2. Section 055213 – Pipe and Tube Railings.
3. Section 055300 – Metal Gratings.
4. Section 057300 – Decorative Metal Railings.

1.2 SUBMITTALS

A. Product Data: For the following:
1. Metal nosings and treads.
2. Grout.

B. Shop Drawings: Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Templates: For anchors and bolts.

D. Samples: For each type and finish of extruded nosing.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

B. Ferrous Metals:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
3. Steel Tubing: ASTM A 500, cold-formed steel tubing.
4. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
5. Slotted Channel Framing: Cold-formed metal channels complying with MFMA-3, 1-5/8 by 1-5/8 inches (41 by 41 mm). Channels made from galvanized steel complying with ASTM A 653/A 653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.079-inch (2-mm) nominal thickness.
6. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

C. Nonferrous Metals:

1. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.
2. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, alloy 6061-T6.
3. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.2 FASTENERS

A. General: Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

2.3 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI #79.

B. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Products:

a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
b. Carboline Company; Carbozinc 621.
c. ICI Devoe Coatings; Catha-Coat 313.
d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
g. Tnemec Company, Inc.; Tneme-Zinc 90-97.

C. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

E. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.4 FABRICATION

A. General: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
2. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
4. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
5. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 24 inches (600 mm) o.c.

B. Miscellaneous Framing and Supports: Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate steel girders for wood frame construction from continuous steel shapes. Where wood nailers are attached to girders with bolts or lag screws, drill holes at 24 inches (600 mm) o.c.
2. Fabricate steel pipe columns for supporting wood frame construction with steel baseplates and top plates welded to pipe with fillet welds the same size as pipe wall thickness.

C. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

1. Lintels in Exterior Walls: Galvanize.

D. Shelf Angles: Fabricate shelf angles of sizes indicated and for attachment to framing. Fabricate with horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c.

1. Shelf Angles in Exterior Walls: Galvanize.
2. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

E. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts.

F. Miscellaneous Steel Trim: Fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Exterior Miscellaneous Steel Trim: Galvanize.

G. Metal Ladders: Comply with ANSI A14.3, unless otherwise indicated.

1. Elevator Pit Ladders: Comply with ASME A17.1.
2. Steel Ladder Construction: Flat bar siderails, with 3/4-inch- (19-mm-) diameter steel bar rungs fitted in centerline of siderails, plug-welded, and ground smooth on outer rail faces. Provide nonslip surfaces on top of each rung.
3. Aluminum Ladder Construction: Extruded channel or tube siderails, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick; with extruded tube rungs, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, fitted into centerline of siderails and fastened by welding or with stainless-steel fasteners or brackets and aluminum rivets. Provide rungs with ribbed tread surfaces.
4. Fabricate ladder safety cages to comply with ANSI A14.3. Fabricate from same metal as ladders to which safety cages are attached and assemble by welding or riveting.
5. Exterior Steel Ladders: Galvanize.

H. Metal Ship's Ladder:

1. Basis of Design Product: Aluminum ships ladder Model SL by Precision Ladder, LLC.

2. Ladder:
   a. Stringers: Extruded aluminum channel, 6005-T5.
   b. Treads: Extruded aluminum channel, 6005-T5.
   c. Floor Mounting Bracket: 2 by 3 by 1/4 inch aluminum angle.
   d. Top Mounting Bracket: 5 by 5 by 2 inch aluminum angle.

3. Handrail:

   a. 1 1/4 inch (32 mm) diameter aluminum pipe, 6061-T-6.

I. Metal Bollards: Fabricate from Schedule 40 steel pipe.

1. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6-mm-) thick steel plate welded to bottom of sleeve.

J. Abrasive Metal Nosings.

1. Cast-Metal Units: Cast aluminum, with an integral abrasive finish.

   a. Manufacturers:

      1) American Safety Tread Co., Inc.
      2) Balco Inc.
      3) Barry Pattern & Foundry Co., Inc.
      4) Granite State Casting Co.
      5) Safe-T-Metal Co.
      6) Wooster Products Inc.

2. Extruded Units: Aluminum, with abrasive filler in an epoxy-resin binder.

   a. Manufacturers:

      1) ACL Industries, Inc.
      2) American Safety Tread Co., Inc.

3) Amstep Products.
4) Armstrong Products, Inc.
5) Balco Inc.
6) Granite State Casting Co.
7) Wooster Products Inc.

b. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
c. Provide solid-abrasive-type units without ribs.

3. Provide anchors for embedding units in concrete, either integral or applied to units.
4. Drill for mechanical anchors and countersink. Locate not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.

B. Steel and Iron Finishes:

1. Hot-dip galvanize items as indicated to comply with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable.
2. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed metal fabrications:

a. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
b. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

3. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.

1. Fit exposed connections accurately together. Weld connections that are not to be left as exposed joints but cannot be shop welded. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.
2. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with nonshrink, nonmetallic grout.

C. Ship's Ladder: Install according to manufacturer's instructions and as indicated on Drawings.

D. Bollards:
   1. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.
   2. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
   3. Fill bollards solidly with concrete, mounding top surface to shed water.

E. Touch up surfaces and finishes after erection.

   1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
   2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Ladders.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 092116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

C. Section 099123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

C. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.05 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Concentrated Loads: Design railing assembly, wall rails, 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. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Dimensions: See drawings for configurations and heights.

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.

F. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured.

D. Welded Joints:
   1. Interior Components: Continuously seal joined pieces by continuous welds.
   2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

D. Conceal anchor bolts and screws whenever possible.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 057000
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative metal units.

B. Exterior Signage.

1.02 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: attachment to building.

B. Section 092116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

C. Section 099600 - High Performance Coatings: powder coat finish.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years of documented experience.

B. Installer Qualifications:

1. Installer specialized in work of type specified with at least ten years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Provide mock-up of assembly (not in place), but a smaller 2'-0" length of "eyebrow" piece and 1'-0" lenght of other pices in powdercoat finish.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against damage during transit, delivery, storage, and installation at site.

B. Inspect materials for damage upon delivery. Replace damaged and unrepairable materials. Ensure replacement materials are indistinguishable from undamaged parts and finishes.

C. Prior to installation, store materials and components under cover in a dry location.

PART 2 PRODUCTS

2.01 DECORATIVE METAL UNITS

A. Interior and Exterior metals to recieve high-performance finish (powder coat):

1. Base Metal: mil steel.
2. Profile: as indicated on drawings.
3. Edges: square (eased).
4. Font: as indicated on drawings.

2.02 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections exposed to view on finished units.

B. Steel Components:
   1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections for delivery to site and as indicated on the drawings..

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Welding Fittings: Factory- or shop-welded; joints and seams ground smooth.

2.04 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).

2.05 FINISHES

A. Steel Finishes:
   1. Primer: Compatible with coating; shop-applied.
   2. High Performance Paint Finish (powdercoat): shop applied.
   3. Color: As selected by Architect from manufacturer's standard range.

2.06 ACCESSORIES

A. Anchors and Fasteners: Provide anchors, fasteners, and other attachment devices required to attach to structure. Ensure attachment devices are of same material as components unless indicated otherwise.
   1. Exposed Fasteners: as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

3.02 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

B. Anchor securely to structure.

C. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.03 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.04 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

C. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 057300-A
EXTERIOR DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior Hand Railing systems.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. 05

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

F. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.

G. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.

H. 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.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.

C. Test Reports: Submit test reports from independent testing agency showing compliance with specified design and performance requirements.

D. Manufacturer's Instructions: Indicate installation.

E. Specimen warranty.

F. Executed warranty.

1.05 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Provide mock-up of railing system, wall-mounted handrail, and guardrail, 2 feet (____ m) long, indicating each type of material, cladding, and finish.

C. Mock-up may remain as part of work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Replace damaged items.

D. Prior to installation, store materials and components under cover in dry location.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard 1-year warranty against defects in materials, fabrication, finishes, and installation commencing on mm-dd-yyyy; complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 RAILING SYSTEMS

A. General: Factory- or shop-fabricated to suit project conditions, for proper connection to building structure, and in largest sizes practical for delivery to site.

B. Performance Requirements:
   1. Comply with ASTM E985.
   2. Comply with ADA Standards.

C. Performance Requirements: Applying loads simultaneously not required; design and fabricate railings and anchorages to resist loads without failure, damage, or permanent set, including:
   1. Lateral Force: 75 lb (333 N) minimum, when tested in accordance with ASTM E935.
   2. Distributed Load: 50 lbf/ft (8756 N/m) minimum, applied vertically and horizontally at top of handrail, when tested in accordance with ASTM E935.
   3. Concentrated Loads: 200 lb (888 N) minimum, applied to handrail horizontally and vertically, in accordance with ASTM E935.

D. Assembly: Use slip-on, nonweld mechanical fittings, flanges, escutcheons, and wall brackets to join lengths, seal open ends, and conceal exposed mounting bolts and nuts.

E. Joints: Machined smooth with hairline seams; tightly fitted and secured.

F. Field Connections: Provide sleeves to accommodate site assembly and installation.

G. Metal Railing: Engineered, post-supported railing system with metal infill.
   1. Configuration: _____.Stair Hand Rail and Ramp Hand Rail
   2. Top Rail: 1-1/2-inch IPS / 1.9-inch OD (38.1 mm IPS / 48.26 mm OD) diameter aluminum pipe or tube, Schedule 40.
   3. Top Rail: 1-1/2- by 1-1/2-inch (38 by 38 mm) square tube, aluminum.
   4. Grip Rail: Round, stainless steel, 1-1/2-inch (38 mm) diameter.
   5. Decorative Flanges for Embedded Posts: Circular, collared cover plate without screw holes.
   6. Wall-Mounted Components: Support railing with 1-1/2-inch (38 mm) clearance from wall using the following:
   7. Fasteners: _____.See plans.

2.02 MATERIALS

A. Steel Components:
   1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
   2. Tubing: ASTM A501/A501M structural tubing, round and shapes as indicated.
   3. Pipe: ASTM A53/A53M Grade B, Schedule 40, black finish.
   4. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized in accordance with ASTM A153/A153M.
   5. Welding Materials: AWS D1.1/D1.1M.

2.03 FABRICATION

A. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   1. Ease exposed edges to small uniform radius.

2. Welded Joints:
    a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.

2.04 FINISHES

A. General: Comply with NAAMM AMP 500-06.
    1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions, and surface blemishes to match sheet.
    2. Protect mechanical finishes on exposed surfaces from damage.
    3. Apply organic and anodic finishes to formed metal after fabrication.
    4. Appearance: Limit variations in appearance of adjacent pieces to one-half of range represented in approved samples. Noticeable variations in same piece are not acceptable. Install components within range of approved samples to minimize contrast.

B. Steel Finishes:
    1. Primer: Compatible with organic coating; shop-applied.
    2. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils, 0.015 inch (0.038 mm).
    3. Color: As selected by Architect from manufacturer's standard range.

2.05 ACCESSORIES

A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

B. Anchors and Fasteners: Provide anchors, fasteners, and other attachment devices required to attach to structure.
    1. Steel Fasteners: ASTM F3125/F3125M, Type 1, galvanized in accordance with ASTM A153/A153M.
    2. Stainless Steel Fasteners: Type 304.

C. Finish Touch-Up Materials: As recommended by manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions are corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, noncumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Test railings for structural performance in accordance with ASTM E935.

C. Manufacturer Services: Provide services of manufacturer's field representative to observe railing installation.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective film from exposed metal surfaces.

C. Metal: Clean exposed metal finishes with potable water and mild detergent in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage material or finish.

END OF SECTION

SECTION 057300-B
REVAMP EXTERIOR DECORATIVE METAL RAILINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. General Requirements are part of this specification and shall apply as if repeated here.
B. Work includes:
    a. Exterior Decorative Metal Panels
    b. Exterior Decorative Metal Panels used as railing or guard infill
C. Related work not included:
    a. Substrates

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative metal panels. 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 items to Project site in time for installation.
B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes of deterioration.

1.3

1.4 DESIGN REQUIREMENTS

A. Panel removal: System shall be non-progressive, allowing removal of any individual panel without necessitating removal of adjacent work.
B. Structural movement: Accommodate movement of supporting structural framing and without causing bowing, buckling, delamination, oil canning, excessive stress on fasteners, or any other detrimental effects.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
    1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces
D. Maximum deviation from vertical and horizontal alignment of erected panels: 0.25" in 20' 0"
E. Maximum deviation from panel flatness shall be 0.10" in 60" panel in any direction for assembled units (non-accumulative).

1.5 SAMPLES

A. Submit samples in accordance with Division 1 Section, Submittals.
B. Submit duplicate, minimum 3-½” x 3-½” samples of each color selected.

1.6 SHOP DRAWINGS

A. Submit shop drawings in accordance with Division 1 Section, Submittals
B. Indicate elevations, profiles, dimensions and thickness of panels.
C. Indicate location and detail of joints including joints necessary to accommodate thermal movement.
D. Indicate attachment clips, joint extrusion system and installation details.
E. Show fastening and anchoring details.
F. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances
G. Drawings for railing and guard infill panels shall be signed and sealed by a Professional Engineer licensed in the jurisdiction where the Project occurs, attesting to the ability of the metal panel's assembly to withstand the specified loads.
H. Panels shall be identified on the shop drawings, using the Specified Identification and as to building location to facilitate panel removal and replacement.

1.7 DELEGATED DESIGN REQUIREMENTS

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the design professional responsible, for each product and system specifically assigned to Contractor to be designed or certified by a design professional
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. Infill at railings and guards: Design metal panel infill for railings and guards, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   1. Structural Performance of infill at railings and guards: Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft

D. Exterior Panels, Structural Performance: Decorative formed metal items, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:
   1. Wind Loads on Exterior Items: As indicated on the *General Structural Notes* on the drawings or if not indicated; 30 lb/sq. ft.

1.8 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Protect finish and edges using a plastic film adhered to panel in accordance with panel manufacturer's recommendations.

B. Store components and materials in accordance with panel manufacturer's recommendations.

1.9 WARRANTY

A. Submit panel manufacturer's written warranty covering failure of factory-applied exterior finish within the warranty period. Warranty period for finish: One year after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURER OF DECORATIVE METAL PANELS

A. Manufacturers of Decorative Metal Railings:Basis of this specification is Revamp Panels, LLC, www.revamppanels.com Products: As Indicated. Products by others may be considered provided the product is submitted for approval in accordance with the Supplementary Instructions to Bidders and Division 1 Specifications, meets the specified requirements and in the opinion of the Architect, conforms to the general properties of the product listed, including color.
   1. Decorative Screen Panel Assembly Part No.: DSPA-[XX-XXXX]-C

2.2 PRODUCTS

A. General: Provide panels as indicated on the Drawings:

2.3 PANEL MATERIALS:

A. Aluminum Panels: Alloy 5052-H32
B. Steel Panels: A36
C. Cor-Ten® Steel: A588

2.4 PANEL FINISHES:

A. Finishes General: All components shall be factory finished for assembly
B. Unfinished: Cleaned, deburred, light DA-sand
C. Cardinal Powder Coat: www.cardinalpaint.com
D. 70% PVDF: Fluoropolymer finish (AAMA 2605)

2.5 COLOR:

A. Color to be matched to color as indicated
   a. Steel

i. Primer Coat: E396-GR1327 “Gray Zinc Rich Primer” at min. 2.0-2.5 mils

b. Aluminum

i. Primer Coat: E305-GR533 “Gray Primer” at min. 2.0-2.2 mils

PART 3 — EXECUTION

3.1 EXAMINATION

A. Examine work of other Sections upon which work of this Section depends.

B. Report any unsatisfactory conditions to Architect in writing. Do not start work until unsatisfactory conditions are rectified.

3.2 PANEL SYSTEM

A. Erect panels and accessories in accordance with system manufacturer’s details and instructions and so as to meet specified design and performance requirements.

B. Finished work shall be securely anchored, free of distortion and surface imperfections, uniform in color and gloss.

C. Use concealed fastenings only, except where exposed fastenings are specifically permitted by Architect in writing.

D. Install panels plumb, true, level and in alignment to established lines and elevations.

E. Where indicated on drawings or as required to complete work of this Section, furnish and install closures, caps, fascia covers and trims with matching panel finish, where exposed.

3.3 CLEAN-UP

A. Remove protective film from panels.

B. Clean exposed panel surfaces in accordance with manufacturer’s instructions.

C. Repair and touch up minor surface damage with color matching high grade enamel, only where permitted by the Architect and only where appearance after touch-up is acceptable to Architect.

D. Replace damaged panels and components that, in opinion of the Architect, cannot be satisfactorily repaired.

END OF SECTION 05 75 43

DIVISION

6

WOOD, PLASTICS, AND COMPOSITES

SECTION 060573
WOOD TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field-applied fire-retardant treatment for wood materials.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data for each treatment product.

C. Manufacturer's instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 FIELD-APPLIED PRESERVATIVE WOOD TREATMENT

2.02 FIELD-APPLIED FIRE-RETARDANT TREATMENT

A. Field-Applied Fire-Retardant:
   1. Products:
      a. Flame Seal LLC, FS, Wood Seal A.
         1) Comply with ASTM E-84 Standards for Class A.
      b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove dust, dirt and other contaminants from treatment surfaces. Remove tarpaulins, dropcloths, strippable protective films, etc., from areas to be treated. Move equipment and stored materials that block or prevent product application.

3.02 INSTALLATION - GENERAL

A. Provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FIELD-APPLIED WOOD TREATMENT

A. Comply with manufacturer's written mixing and application instructions.

B. Apply wood treatment to items indicated on drawings (exterior finished wood soffits).

C. Field-Applied Fire-Retardant Coating: Apply coating in accordance with manufacturer's instructions.
   1. Apply to all sides, including concealed sides and cut ends before installation.
   2. Apply prior to finish stain installation.
   3. Allow for authoity having jurisdiction to review installation.

3.04 PROTECTION

A. Protect fire-retardant-treated wood surfaces from moisture and damp before, during, and after treatment.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Rough opening framing for doors, windows, and roof openings.

C. Integral exterior wall thermal insulation, sheathing, and weather barrier.

D. Sheathing.

E. Subflooring.

F. Roof and canopy decking.

G. Underlayment.

H. Roof-mounted curbs.

I. Roofing nailers.

J. Roofing cant strips.

K. Preservative treated wood materials.

L. Fire retardant treated wood materials.

M. Miscellaneous framing and sheathing.

N. Communications and electrical room mounting boards.

O. Concealed wood blocking, nailers, and supports.

P. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. PS 2 - Performance Standard for Wood Structural Panels; 2019.

I. PS 20 - American Softwood Lumber Standard; 2025.

J. SPIB (GR) - Standard Grading Rules; 2021.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and all sheathings.

C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, Rough (unsurfaced).

B. Moisture Content: Kiln-dry or MC15.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Roof/Canopy Deck Sheathing: PS 1 or PS 2 type, rated Single Floor.
   1. Panel Type: Plywood.
   2. Bond Classification: Exterior.
   3. Fire-rated as indicated on the drawings.

B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch (____ mm).
   1. Products:
      a. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
      b. Georgia-Pacific Gypsum: DensDeck Sheating: www.gpgypsum.com/#sle.

C. Building Wall Sheathing: Rigid insulation faced with sheathing and weather barrier.
   1. Construction Panel wih Insulaion Board:of 2 1/4 inch thickness (R-Value of 15) faced with 1/2 inch sheating and weather barrier.
   2. Panel Thickness: 2 3/4 inches.
   3. Finished Panel: Comply with NFPA 285, ASTM E84, ASTM E119, ASTM C518, ASTM D1621.
   4. Products:
      a. Dupont, ArmorWall Plus Fire-Rated Structural INsulated Sheathing.
         1) Use compatible Du Pont DuraGuard WD for window and door opening flashing tape.
         2) Use compatible DuPont LiquidArmor for penetrations and fastners for a complete air-and water-resittive weather barrier.
         3) Use DuPont DuraGuard CM privmerless self-adhered flashings.

D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. All other sheathing: use type of fasteners recommended by manufacturers.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

B. All sheathing treatments to be factory applied.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.
   10. Wall mounted televisions.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Roof / Canopy Deck Underlayment: Screw to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails or screws.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
   1. Install adjacent boards without gaps.
   2. Size: 48 by 96 inches (2440 by 4880 mm), installed horizontally at ceiling height.

3.06 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.07 CLEANING

A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 061053
LANDSCAPE ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cedar 1x6s for fence.

B. Preservative treatment.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. PS 20 - American Softwood Lumber Standard; 2025.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimensional Lumber: Cedar 1x6s to be #1 Common per WWPA standards

B. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 ACCESSORIES

A. Application Tools: Brushes, rollers, or spray equipment as recommended by stain manufacturer.

B. Cleaning Solvents: Mineral spirits for tool cleaning and accidental drips.

C. Fasteners and Anchors:
   1. See plans
   2. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.03 SITE APPLIED WOOD TREATMENT

A. Oil-Based Semi-Transparent Stain:

1. Type: Oil-based, penetrating, semi-transparent wood stain with integrated water repellency and UV protection.
    a. Color: Honey (or specific manufacturer's color name, e.g., "Natural Cedar," "Honey Pecan"). Match approved sample.
2. Performance Characteristics:
    a. Formulated for exterior exposure on cedar lumber.
    b. Contains transoxide pigments or similar for enhanced UV resistance.
    c. Provides hydrophobic properties to repel water.
    d. Resistant to mildew and fungal growth.
    e. Does not form a continuous film that can peel or flake.
3. Acceptable Manufacturers (Basis of Design - substitutions require approval):
    a. Ready Seal: "Natural Cedar"
    b. Penofin: "Siding & Deck Finish" (choose appropriate light/honey shade)
    c. Messmer's: "UV Plus" (choose appropriate light/honey shade)

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to application, examine all cedar lumber surfaces to receive stain.

B. Verify surfaces are clean, dry, free from dirt, dust, grease, loose fibers, mill glaze, efflorescence, and any other contaminants that would impair adhesion or appearance.

C. Verify wood moisture content is within the manufacturer's acceptable range (typically below 15%).

D. Report any conditions that may adversely affect the application or performance of the stain to the Landscape Architect/Owner for resolution prior to commencing work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 3.2 SURFACE PREPARATION

A. New Cedar:

B. }Allow new cedar to weather for manufacturer-recommended period (if any) to open pores, or perform light sanding (100-120 grit) to remove mill glaze.

C. Clean surfaces with a mild wood cleaner suitable for cedar, rinsing thoroughly with clean water. Allow to dry completely (minimum 48-72 hours, or until moisture content is appropriate) before staining.

3.03 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.04 SITE APPLIED WOOD TREATMENT

A. Stir stain thoroughly before and during application to ensure uniform color and consistency.

B. Apply stain evenly and uniformly according to manufacturer's published instructions, using brushes, rollers, or spray equipment. Avoid excessively thick coats.

C. For spray application, back-brush immediately to ensure even penetration and to prevent lap marks or puddling.

D. Apply a single coat as per manufacturer's recommendation for semi-transparent finishes, ensuring full saturation without creating a film build. If manufacturer allows two coats for deeper color, ensure the first coat is dry to touch but not fully cured before applying the second, as per instructions.

E. Work with the grain of the wood.

F. Do not apply stain in direct sunlight on hot days, which can lead to flash drying and uneven appearance. Work in smaller sections to maintain a wet edge.

G. Immediately wipe off any drips or puddles to avoid uneven drying or shiny spots.

H. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

I. Allow preservative to dry prior to erecting members.

3.05 CLEANING

A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

D. Clean tools and equipment immediately after use with mineral spirits.

E. Dispose of all waste materials, rags, and containers in accordance with local environmental regulations. Rags soaked with oil-based stain are combustible; soak in water and lay flat to dry before disposal, or store in sealed metal containers.

3.06 PROTECTION

A. Protect newly stained surfaces from rain, heavy dew, and traffic until fully dry to the touch and adequately cured. Provide temporary coverings if necessary.

B. Take measures to prevent damage from other trades until final acceptance.

END OF SECTION

SECTION 062000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

B. Wood casings and moldings.

1.02 RELATED REQUIREMENTS

A. Section 060573 - Wood Treatment: fire treated application for exterior wood at canopies and soffits.

B. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

C. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

D. Section 081416 - Flush Wood Doors: oordinated finish.

E. Section 095425 - Suspended Wood Ceilings: Cooridinated finish.

F. Section 099113 - Exterior Painting: Painting of finish carpentry items.

G. Section 099123 - Interior Painting: Painting of finish carpentry items.

H. Section 101423 - Panel Signage: coordinated wood and finish.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, installation of associated and adjacent components, and finish with other finished wood items.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

B. Protect from moisture damage.

C. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

B. Exterior Woodwork Items:
   1. Wood plank exterior wall cladding and column cover cladding: prepare for field stain.
   2. Soffits and Canopy undersides: prepare for field stain finish.
      a. Prepare for field wood fire retardant treatment.
      b. Coordinate with authority having jurisdiction to review application.

C. Interior Woodwork Items:

1. Interior panels signage: prepare for field stain.
2. Interior wood doors: prepare for field stain.

2.02 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Fasteners: Of size and type to suit application; apply wood filler finish in concealed locations and powder coat finish in exposed locations.

2.03 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Primer: Alkyd primer sealer.

C. Wood Filler: Solvent base, tinted to match surface finish color.

2.04 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.04 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Site Finishing: See Section 099113 and 099123.

C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.05 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

D. Factory finishing.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 062000 - Finish Carpentry: Miscellaneous cabinetry for coordination.

C. Section 096500 - Resilient Flooring: rubber base installation at toe kick.

D. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. BHMA A156.9 - Cabinet Hardware; 2020.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, locksets, and laminates, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
   1. Finish - Exposed Exterior Surfaces: Decorative laminate.
   2. Finish - Concealed Surfaces: melamine.
   3. Casework Construction Type: Type A - Frameless.
   4. Layout for Cabinet and Door Fronts: Flush panel.
   5. Cabinet Style: Flush overlay.
   6. Cabinet Doors and Drawer Fronts: Flush style.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.

2.04 LAMINATE MATERIALS

A. Manufacturers:
   1. Wilsonart LLC: www.wilsonart.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.
   1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, colors as indicated, finish as indicated.

2.05 COUNTERTOPS

A. Countertops: See also Section 123600for other countertop types.

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Edges: of plastic laminate.
   1. Color: same as adjacent cabinet or countertop face.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Adjustable Drawer Organization Systems: Drawer trays, dividers, and connectors.
   1. Products:
      a. Blum, Inc; AMBIA-LINE; www.blum.com/#sle.

G. Grommets: Standard plastic grommets for cut-outs, in color as selected from manufacturers standard colors.

2.07 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: As indicated on drawings.
   2. Product Grade: Grade 2.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.

C. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.

1. Materials: Steel; T-shape cross-section as indicated on drawings.
2. Products:
   a. A&M Hardware, Inc; Heavy-Duty Hybrid Brackets: www.aandmhardware.com/#sle.

D. Drawer and Door Pulls: as indicated on drawings.

E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

F. Drawer Slides:
1. Type: Full extension.
2. Static Load Capacity: Commercial grade.
3. Stops: Integral type.

G. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

2.08 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 068316
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: preparation of surfaces for installation.

1.03 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.

B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

C. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, 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. Samples: Submit two samples 2 inches by 2 inches inch (____x____ mm) in size illustrating material and surface design of panels.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Crane Composites, Inc: www.cranecomposites.com/#sle.
   2. Marlite, Inc: www.marlite.com/#sle.
   3. Nudo Products, Inc: www.nudo.com/#sle.
   4. Panolam Industries International, Inc: www.panolam.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
   2. Panel Thickness: 0.10 inch (2.5 mm).
   3. Surface Design: Embossed.
   4. Color: As selected by Architect.
   5. Attachment Method: Mechanical fasteners concealed by trim, with sealant in joints.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.

1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Impact Strength: Greater than 6 ft lb force per inch (320 J per m), when tested in accordance with ASTM D256.
4. Sanitation and Cleanability: Comply with 9 CFR 416.2.
5. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.

B. Trim: Vinyl; color coordinating with panel.

C. Fasteners: Nylon rivets.

D. Adhesive: Type recommended by panel manufacturer.

E. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

C. Verify that layout of hangers will not interfere with other work; make adjustments in layout as necessary.

D. Do not begin ceiling installation until services above ceiling are complete except for final trim

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener, spaced as indicated by panel manufacturer.

D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

F. Install panels with manufacturer's recommended gap for panel field and corner joints.

G. Drive fasteners to provide snug fit, and do not over-tighten.

H. Place trim on panel before fastening edges, as required.

I. Fill channels in trim with sealant before attaching to panel.

J. Install trim with adhesive and screws or nails, as required.

K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

L. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

DIVISION

7

THERMAL AND MOISTURE PROTECTION

SECTION 070553
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 FIELD CONDITIONS

A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.

B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

A. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl sign with factory applied adhesive backing.

B. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Locate markings as required by ICC (IBC).

B. Install adhered markings in accordance with manufacturer's instructions.

C. Install neatly, with horizontal edges level.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 071113
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

B. Protection boards.

1.02 RELATED REQUIREMENTS

A. Section 072100 - Thermal Insulation: Rigid insulation board used as protection board.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).

B. ASTM D43/D43M - Standard Specification for Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing; 2000 (Reapproved 2018).

C. ASTM D449/D449M - Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 2003 (Reapproved 2021).

D. ASTM D450/D450M - Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing; 2007 (Reapproved 2018).

E. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).

F. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013, with Editorial Revision (2019).

G. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide properties of primer, bitumen, and mastics.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Karnak Corporation; _____: www.karnakcorp.com/#sle.

B. Mar-flex Waterproofing & Building Products; _____: www.mar-flex.com/#sle.

C. W. R. Meadows, Inc; _____: www.wrmeadows.com/#sle.

D. Substitutions: See Section 016000 - Product Requirements.

E. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Asphalt-Base Emulsion for Metal Protective Coating: ASTM D1187/D1187M, Type I - Continuous water exposure within few days after drying or Type II - Continuous weather exposure after drying.
   2. Emulsified Asphalt for Roofing Protective Coating: ASTM D1227/D1227M, Type II, Class 1 - Mineral colloid emulsifying agents with non-asbestos fibers.
   3. VOC Content: Not more than permitted by local, State, and federal regulations.
   4. Applied Thickness: 1/16 inch (1.5 mm), minimum, wet film.

2.03 ACCESSORIES

A. Protection Board: 1/8-inch (3 mm) thick biodegradable hardboard.
   1. Rigid foundation insulation may be used in lieu of protection board.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Foundation Walls: Apply two coats of asphalt dampproofing.

B. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

C. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

D. Apply bitumen by mop, spray, or trowel.

E. Apply bitumen in one coat, continuous and uniform, at a rate of 25 sq ft/gal (0.6 sq m/L) per coat.

F. Seal items watertight with mastic, that project through dampproofing surface.

G. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.

H. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION

SECTION 071300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Self-adhered modified bituminous sheet membrane.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete substrate.

B. Section 072100 - Thermal Insulation: Insulation used for protective cover.

1.03 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

E. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2025.

F. ASTM D6506/D6506M - Standard Specification for Asphalt Based Protection Board for Below-Grade Waterproofing; 2001, with Editorial Revision (2018).

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

H. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for membrane, surface conditioner, and joint and crack sealants.

1.05 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.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until liquid or mastic accessories have cured.

PART 2 PRODUCTS

2.01 SHEET WATERPROOFING APPLICATIONS

A. Self-Adhered Modified Bituminous Sheet Membrane:
   1. Location: as indicated.
   2. Cover with rigid insulation as indicated or cover board where rigid insulation is not indicated.

2.02 SHEET WATERPROOFING MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane:
   1. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
   2. Sheet Width: 36 inches (0.914 m), minimum.
   3. Tensile Strength:

a. Membrane: 325 psi (2.24 MPa), minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches (50 mm) per minute.

4. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
5. Water Vapor Permeance: 0.05 perm (2.9 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
6. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F (minus 29 degrees C), 180 degree bend on 1 inch (25 mm) mandrel.
7. Adhesion: 150 psi (1.03 MPa), minimum, measured in accordance with ASTM D4541.
8. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
9. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet (61 m) head of water applied in accordance with test method ASTM D5385/D5385M.
10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
11. Products:
    a. As recommended by the membrane manufacturer.

2.03 ACCESSORIES

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

B. Protection Board: Rigid insulation; see Section 072100.

C. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
   1. Hardboard, 1/8 inch (3 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.

F. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.

D. Overlap edges and ends, minimum 3 inches (76 mm), seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

G. Coordinate with drain installation.

H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

I. Seal membrane and flashings to adjoining surfaces.

3.04 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at foundation wall.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-In-Place Concrete:

B. Section 061000 - Rough Carpentry: Installation requirements for board insulation as part if integrated thermal insulation, sheathing, and weather barrier at exterior perimeter walls.

C. Section 071113 - Bituminous Dampproofing: rigid insulation used as protection board.

D. Section 071300 - Sheet Waterproofing: Rigid insulation used as protection board and thermal insulation.

E. Section 072119 - Foamed-In-Place Insulation: Thermal insulation fill for continuous insulation at exterior walls.

F. Section 092116 - Gypsum Board Assemblies: Installation requirements for batt insulation in framed walls (interior and exterior) for both thermal and acoustical purposes.

1.03 REFERENCE STANDARDS

A. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2023.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation at Perimeter of Foundation: Expanded polystyrene (EPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Expanded Polystyrene (EPS) Board Insulation: Comply with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
   4. Board Edges: Square.
   5. Type and Compressive Resistance: Type XI, 5 psi (35 kPa), minimum.
   6. Type and Water Absorption: Type XI, 4.0 percent by volume, maximum, by total immersion.
   7. Products:
      a. Atlas Molded Products, a Division of Atlas Roofing Corporation; ThermalStar EPS Wall Insulation Board: www.atlasmoldedproducts.com/#sle.

b. Atlas Molded Products, a Division of Atlas Roofing Corporation; ThermalStar EPS Laminated Wall Insulation (LWI): www.atlasmoldedproducts.com/#sle.
c. Diversifoam Products: www.diversifoam.com/#sle.
d. InsulFoam LLC: www.insulfoam.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
1. Application: Sealing of interior circular penetrations, such as pipes or cables.
2. Width: Are required for application.

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.
1. Place boards to maximize adhesive contact.
2. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. In exterior wall crevices.
   3. At junctions of dissimilar wall and roof materials.
   4. In underside of roofs and ceilings.
   5. In underside of floor decks.

B. Foamed-in-place intumescent insulation, single-layer monolithic system.

C. Protective intumescent coating.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

C. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

D. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than _____ years of documented experience.

1.05 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foamed-In-Place Insulation:
   1. DuPont; FROTH-PAK 200 Foam System
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Foamed-In-Place Insulation: flexible, open cell or closed cell, water vapor permeable polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.

2. Thermal Resistance: R-value (RSI-value) of 6.2 (___), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
3. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
4. Class-A Fire Rated.

2.03 ACCESSORIES

A. Primer: As required by insulation manufacturer.

B. Protective Coating: Sprayed, treated with flame retardants as required to comply with applicable codes.
1. Coating Type: Recycled paper.
2. Bond Strength: 100 psf (488 kPa), minimum.
3. Flame Spread/Smoke Developed Index: 5/5, Class A, when tested in accordance with ASTM E84.

C. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.
1. Coating Type: Single component, water-based.
2. Protected Insulation Type: Spray polyurethane foam (SPF).
3. Application: Apply using brush, roller, or airless sprayer.
4. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Apply to achieve a thermal resistance equal to that of the wall thermal resistance elsewhere.

D. Apply protective coating monolithically, without voids, to fully cover foam insulation, to achieve fire rating required.

E. Patch damaged areas.

F. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

G. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 074213
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wall panel substrate.

B. Section 072500 - Weather Barriers: Weather barrier under wall panels.

C. Section 079200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

D. Section 092116 - Gypsum Board Assemblies: Wall panel substrate and furring channels.

1.03 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. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit two samples of each color of wall panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum five years of documented experience.

1.06 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Construct mock-up, ten feet (____ m) long by ten feet (____ m) wide; include panel system, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, _____, and related insulation in mock-up.

C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.08 FIELD CONDITIONS

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

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide thirty manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners:
   1. Citadel Architectural Products: Envelope 2000 Deep-Reveal (D-RV) System.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior wall panels and subgirt framing assembly.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   7. Corners: Factory-fabricated in one continuous piece with minimum ___-inch (___ mm) returns.
   8. Provide continuity of weather barrier seal at building enclosure elements in accordance with requirements; see Section 072500.

B. Exterior Wall Panels:
   1. Profile: Vertical and horizontal, as indicated; style as indicated.
   2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
   3. Material: Precoated aluminum sheet: 0.024 inch thickness.
   4. Panle Width: standard sizes to meet the layout indicated on the drawings.
   5. Color: As indicated on drawings.

C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Galvanized steel.

2.03 MATERIALS

A. Precoated Aluminum Sheet: with smooth surface tecture; continuous-coal coated on exposed surfaces with specified finish coating.

B. Select materials with surface flatness, smoothness, and lack of surface blemishes where exposed to view in finished system.

2.04 FINISHES

A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over _____ primer.

B. High Performance Organic Coating System: Multi-coat, high-durable polyester system; color as indicated on drawings.
   1. Systems:
      a. Two-coat in accordance with AAMA 2604.
      b. Three-coat in accordance with AAMA 2605.

2.05 ACCESSORIES

A. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   1. Products:
      a. As recommended by manufacturer.

B. Fasteners: Manufacturer's standard type to suit application; steel, hot dip galvanized. Fastener cap same color as exterior panel.

C. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify weatehr barrier, see Section 061000, has been installed over wall panel substrate/sheathing.

3.02 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated or per the manufacturers recommendations.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.

B. Fasten panels to structural supports; aligned, level, and plumb.

C. Locate joints over supports.

D. Lap panel ends 2 inches (51 mm), minimum.

E. Use concealed fasteners unless otherwise indicated by Architect.

3.04 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch (1.6 mm), maximum.

B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch (6.4 mm), maximum.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove site cuttings from finish surfaces.

C. Remove protective material from wall panel surfaces.

D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.06 PROTECTION

A. Protect metal wall panels until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 075300
ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane application.

B. Hypalon, chlorosulfonated polyethylene - CSPE roofing membrane

C. Insulation, flat and tapered.

D. Vapor retarder.

E. Cover boards.

F. Roofing cant strips, stack boots, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 053100 - Steel Decking: Placement of acoustical insulation for deck flutes.

B. Section 061000 - Rough Carpentry: Wood cant strips.

C. Section 074213 - Metal Wall Panels: coordination of coping installation.

D. Section 077123- Manufactured Gutters and Downspouts: downspout coordination.

E. Section 077200 - Roof Accessories: roof hatch coordination.

F. Mechanical Division: roof-mounted equipment.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. FM (AG) - FM Approval Guide; Current Edition.

E. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).

F. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

G. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated counterflashings and roof curbs installed under other sections.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a two year period after Date of Substantial Completion.

C. Provide ten year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. KEE Membrane Materials:
   1. Seaman Corporation, FiberTite-SM
   2. 45 mil thickness.
   3. Fully adhered system.

B. Insulation:
   1. Dow: www.dow.com/#sle.
   2. GAF: www.gaf.com/#sle.
   3. Johns Manville: www.jm.com/#sle.
   4. Owens Corning Corporation: www.owenscorning.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

C. Cover Boards:
   1. As indicated on the drawings or as recommended by the roofing membrane manufacturer..
   2. Thickness: 1/4" minimum.

2.02 ROOFING - UNBALLASTED APPLICATIONS

A. Flexible Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and cover board.

B. Roofing Assembly Requirements:
   1. Sheet roll goods for roof covereings.
   2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.

C. Acceptable Insulation Types - Constant Thickness Application:
   1. Single layer of polyisocyanurate or extruded polystyrene board.

D. Acceptable Insulation Types - Tapered Application: as indicated on the drawings .

1. Fully-adhered application.
2. Tapered polyisocyanurate or extruded polystyrene board.

E. Surfacing: Colored integral roof coating.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: KEE; internally reinforced with fabric or scrim.
1. Thickness: 45 mil, 0.045 inch (1.1 mm), minimum.
2. Solar Reflectance: 0.75, minimum, initial, and 0.64, minimum, 3-year, certified by Cool Roof Rating Council.
3. Color: White.
4. Tensile Stregth: 8500 psi minimum measured in accordance with ASTM D882.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Vapor Retarder: Reinforced Kraft paper laminate, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
1. Fire-retardant adhesive.

D. Flexible Flashing Material: Same material as membrane.

2.04 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
1. Thickness: 1/4 inch (6.4 mm), fire-resistant.
2. Products:
a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
2. Board Edges: Square.
3. Products:
a. Dow Chemical Company; ____: www.dow.com/#sle.
b. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
c. Johns Manville; ENRGY 3 CGF - Flat and Tapered: www.jm.com/#sle.
d. Mule-Hide Products Co, Inc; Poly ISO Flat: www.mulehide.com/#sle.
e. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.
f. Substitutions: See Section 016000 - Product Requirements.

B. Extruded Polystyrene (XPS) Board Insulation: Complying with ASTM C578, with natural skin surfaces.
1. Board Size: 48 by 96 inches (1220 by 2440 mm).
2. Board Edges: Square.

2.06 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Cant Strips: Wood; pressure preservative treated.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

E. Membrane Adhesive: As recommended by membrane manufacturer.

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Insulation Adhesive: As recommended by insulation manufacturer.

H. Sealants: As recommended by membrane manufacturer.

I. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Size: As indicated on drawings.
   3. Surface Color: White or Yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

G. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

H. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (457 mm).

I. Do not apply more insulation than can be covered with membrane in same day.

3.03 INSTALLATION - MEMBRANE

A. Install elastomeric membrane roofing system in accordance with manufacturer's recommendations and NRCA (WM) applicable requirements.

B. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

C. Shingle joints on sloped substrate in direction of drainage.

D. Fully Adhered Application: Apply adhesive to substrate at rate of as recommended by membrane manufacturer (____). Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

E. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

F. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

G. Around roof penetrations, seal flanges and flashings with flexible flashing.

H. Coordinate installation of roof drains and sumps and related flashings.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 077123
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

1.02 RELATED REQUIREMENTS

A. Section 075300 - Elastomeric Membrane Roofing: integrated flashing coordination.

1.03 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. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Samples: Submit two samples, 6 inch (____ mm) long illustrating component design, finish, color, and configuration.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gutters and Downspouts:
   1. Alside, Inc: www.alside.com/#sle.
   2. ATAS International, Inc: www.atas.com/#sle.
   3. Cheney Flashing Company: www.cheneyflashing.com/#sle.
   4. Drexel Metals Inc: www.drexmet.com/#sle.
   5. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
   6. Metal-Era Inc: www.metalera.com/#sle.
   7. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc: www.saf.com/persys/#sle.
   8. Substitutions: See Section 016000 - Product Requirements.

2.02 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 PVDF (polyvinylidene fluoride) coating.
   2. Color: As selected by Architect from manufacturer's standard colors.

2.03 COMPONENTS

A. Gutters: SMACNA rectangular style profile.

B. Anchors and Supports: Profiled to suit gutters and downspouts.

1. Anchoring Devices: Type recommended by fabricator.

2.04 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

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.

2.05 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that surfaces are ready to receive work.

3.02 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

END OF SECTION

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hatches.

1.02 RELATED REQUIREMENTS

A. Section 075300 - Elastomeric Membrane Roofing: coordination of flashings.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
   1. Bilco Company; model number as per the drawings: www.bilco.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch (2.3 mm) thick.
   2. Insulation: Manufacturer's standard; 1 inch (25 mm) rigid glass fiber, located on outside face of curb.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf (1.92 kPa) live load.
   2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch (2.3 mm) thick, liner 0.04 inch (1.0 mm) thick.
   3. Insulation: Manufacturer's standard 1 inch (25 mm) rigid glass fiber.
   4. Gasket: Neoprene, continuous around cover perimeter.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 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

SECTION 078400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not.

1.02 RELATED REQUIREMENTS

A. Section 070553 - Fire and Smoke Assembly Identification.

B. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

F. ITS (DIR) - Directory of Listed Products; Current Edition.

G. FM (AG) - FM Approval Guide; Current Edition.

H. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

D. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

B. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:

1. Dow: www.dow.com/#sle.
2. Hilti, Inc: www.hilti.com/#sle.
3. Pecora Corporation: www.pecora.com/#sle.
4. Sika Corporation: usa.sika.com/#sle.
5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
6. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
7. Substitutions: See Section 016000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints:
      a. Do not seal interior joints indicated on drawings as not sealed.
      b. Do not seal gaps and openings in gypsum board and suspended ceilings
      c. Do not seal through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
      d. Seal the following joints:
         1) Joints between door frames and window frames and adjacent construction.
         2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
   2. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be covered with expansion joint cover assemblies.
      c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
      d. Joints where sealant installation is specified in other sections.
      e. Joints between suspended ceilings and walls.

B. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M, A, G, and O; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   5. Color: To be selected by Architect from manufacturer's standard range.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Color: White.

C. Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
   1. Color: White.

2.05 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

DIVISION

8

OPENINGS

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Glass for doors and borrowed lites.

C. Section 081416 - Flush Wood Doors: Wood doors for installing in hollow metal frames.

D. Section 092116 - Gypsum Board Assemblies: Installation of frames in steel stud walls.

E. Section 099113 - Exterior Painting: Field painting.

F. Section 099123 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NFPA: National Fire Protection Association.

D. SDI: Steel Door Institute.

E. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

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

I. 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.

J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

N. ITS (DIR) - Directory of Listed Products; Current Edition.

O. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames; 2012.

P. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

Q. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

R. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

S. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

U. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.

V. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

W. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

X. UL (DIR) - Online Certifications Directory; Current Edition.

Y. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

Z. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

AA. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than _____ years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.

3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.
   6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
   7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

C. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      a. Attach fire rating label to each fire rated unit.
   4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   3. Weatherstripping: Separate, see Section 087100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Transom Bars: Fixed, of profile same as jamb and head.

I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

J. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. Glazing: As specified in Section 088000.

B. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 087100.

F. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

B. Section 087100 - Door Hardware.

C. Section 088000 - Glazing.

D. Section 099113 - Exterior Painting: Field finishing of

E. Section 099123 - Interior Painting: Field finishing of doors.

F. Section 099123 - Interior Painting: Field finishing of doors.

G. Section 099300 - Staining and Transparent Finishing: Field finishing of doors.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings; 2023.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

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. ITS (DIR) - Directory of Listed Products; Current Edition.

I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

J. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.

K. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

L. UL (DIR) - Online Certifications Directory; Current Edition.

M. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of door construction, 6 by 6 inches (____) in size cut from top corner of door.

E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

F. Specimen warranty.

G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than five years of documented experience.
   1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than five years of documented experience.

C. Woodwork Quality Assurance Program:
   1. Provide labels indicating that the 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 quality assurance program.
   3. Provide designated labels on installed products as required by quality assurance program.
   4. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Haley Brothers: www.haleybros.com/#sle.
   2. Horton Automatics, a division of Overhead Door Corporation; FlexBarn: www.overheaddoor.com/#sle.
   3. Krieger Specialty Products: www.kriegerproducts.com/#sle.
   4. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
   5. Oregon Door: www.oregondoor.com/#sle.
   6. VT Industries, Inc: www.vtindustries.com/#sle.
   7. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS

A. Doors:
   1. Quality Standard: Custom Grade, Standard Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
3. Wood veneer facing for field transparent finish.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Species as specified above, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
1. Vertical Edges: Any option allowed by quality standard for grade.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
1. Provide solid blocks at lock edge for hardware reinforcement.
2. Provide solid blocking for other throughbolted hardware.

C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. Provide edge clearances in accordance with the quality standard specified.

2.06 ACCESSORIES

A. Hollow Metal Door Frames: See Section 081113.

B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
1. Frame Material: 18 gauge, 0.0478 inch (1.21 mm), galvanized steel.

C. Glazing: See Section 088000.

D. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

E. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Field-Finished Doors: Trimming to fit is acceptable.
   1. Adjust width of non-rated doors by cutting equally on both jamb edges.
   2. Trim maximum of 3/4 inch (19 mm) off bottom edges.
   3. Trim fire-rated doors in strict compliance with fire rating limitations.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

F. Install door louvers plumb and level.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. See Door and Frame Schedule appended to the drawings.

END OF SECTION

SECTION 083100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Coordination of mounting into walls.

B. Section 099123 - Interior Painting: Field paint finish.

C. Division 23 - HVAC: Quantities, location(s) and size(s) of access doors required for HVAC units.

1.03 REFERENCE STANDARDS

A. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

B. 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; 2023, with Editorial Revision.

C. FM (AG) - FM Approval Guide; Current Edition.

D. ITS (DIR) - Directory of Listed Products; Current Edition.

E. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five 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

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:
   1. Location: as required (regardless if shown on the drawings or not).
   2. Panel Material: Steel.
   3. Size: 12 by 12 inches (305 by 305 mm) or as needed for required access.
   4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
   6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.

B. Fire-Rated Wall-Mounted or Ceiling-Mounted Units:
   1. Location: as required (regardless if shown on the drawings or not).
   2. Wall Fire-Rating: As indicated on drawings or as needed for required access.
   3. Panel Material: Steel.
   4. Size: 12 by 12 inches (305 by 305 mm).

C. Ceiling-Mounted Units:
   1. Location: as required (regarless if shown on the drawings or not.

2. Panel Material: Steel.
3. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
4. Size - Other Ceilings: 12 by 12 inches (305 by 305 mm) or as required for access.
5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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

SECTION 083200
SLIDING GLASS DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory fabricated sliding glazed doors with frames and operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Product and execution requirements for glass type and installation.

C. Section 092116 - Gypsum Board Assemblies: Installation in framed walls.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

C. AAMA 1801 - Voluntary Specification for the Acoustical Rating of Exterior Windows, Doors, Skylights and Glazed Wall Sections; 2021.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

G. ASTM E413 - Classification for Rating Sound Insulation; 2022.

H. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation; 2022.

I. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems; 2014 (Reapproved 2023).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, information on glass and glazing, and descriptions of hardware and accessories.

C. Shop Drawings: Indicate opening dimensions, elevations of different types, and framed opening tolerances.

D. Samples: Two samples, 12 by 12 inch (305 by 305 mm) in size showing typical sliding door panel corner construction, accessories, and finishes.

E. Door Hardware: Two samples of each type of hardware.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for door installation.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a 2-year period after Date of Substantial Completion.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum Sliding Doors:
   1. Kawneer 1010 Sliding Mall Fronts.

2.02 SLIDING GLASS DOORS

A. Aluminum Sliding Doors: Extruded aluminum unit frame and operable panel frame, factory fabricated, factory glazed; complete with integral sloped sill/threshold, flashings, and anchorage devices.
   1. Configuration: One fixed panel and one horizontal sliding panel.
   2. Finish: Permafluor high performance coating.
   3. Color: As scheduled.
   4. Frame Depth: 2 1/2 inches (___ mm), minimum.
   5. Aluminum Members: Factory finished; screw lock corner construction.
   6. Drainage: Provide drainage to exterior for moisture entering joints and glazing spaces and for condensation occurring within frame construction.
   7. Glass Stops: Same material and color as frame, sloped for wash.
   8. Operable Panels: Stainless steel bottom rollers; adjustable.

B. Construction: Factory assemble door frame as one unit, including head jambs, and sill; factory assemble operating and fixed panels.
   1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims around perimeter of assemblies.
   2. Joints and Connections: Flush, hairline width, and waterproof; accurately and rigidly joined corners.
   3. Sills: One piece, sloped to drain, with integral roller track.

2.03 COMPONENTS

A. Door Product Type: SD - Sliding door, in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

B. Glass and Glazing Materials: See Section 088000.

2.04 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: STC rating of 35, OITC rating of ___ , when tested in accordance with ASTM E90, ASTM E1425, or AAMA 1801 and ratings derived from ASTM E413 and ASTM E1332, respectively.

2.05 ASSEMBLY

A. Factory assemble door frame as one unit, including head, jambs, and sill; factory assemble operating and fixed panels.

B. Sizes: Allow for tolerances of rough framed openings, clearances, and shims around perimeter of assemblies.

C. Joints and Connections: Flush, hairline width, and waterproof; accurately and rigidly joined corners.

D. Sills: One piece, sloped to drain, with integral roller track.

2.06 ACCESSORIES

A. Pull Handles: optional edge pull.

B. Sliding Panel Bottom Rollers: candem casters, adjustable from interior.

C. Limit Stops: Resilient rubber.

D. Anchors: Hot-dipped galvanized or stainless steel.

E. Sills: fully recessed tracks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on shop drawings.

3.02 INSTALLATION

A. Install sliding glass door units in accordance with manufacturer's instructions.

B. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Use anchorage devices to securely fasten sliding door assembly to wall construction without distortion or imposed stresses.

D. Place threshold in bed of sealant.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

C. Maximum Variation from Level: 1/16 inch (1.5 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 feet (3.0 m) straight edge.

3.04 ADJUSTING

A. Adjust hardware for smooth operation.

3.05 CLEANING

A. Remove protective material from factory finished surfaces.

B. Remove labels and visible markings.

C. Wash surfaces by method recommended and acceptable to sealant and sliding glass door manufacturer; rinse and wipe surfaces clean.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

D. Door hardware.

1.02 RELATED REQUIREMENTS

A. Section 051200 - Structural Steel Framing: Steel attachment members.

B. Section 061000 - Rough Carpentry: Backing, blocking and shims for installation.

C. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

D. Section 087100 - Door Hardware: Hardware items other than specified in this section.

E. Section 088000 - Glazing: Glass and glazing accessories.

F. Section 092116 - Gypsum Board Assemblies: Installation in framed walls.

G. Section 122400 - Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

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 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

F. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

G. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

H. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

K. 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.

L. 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).

M. 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).

N. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

O. 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).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Samples: Submit two samples 6 inches (____x____ mm) in size illustrating finished aluminum surface, glass, glazing materials.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Tubelite, Inc; E14000: www.tubeliteinc.com/#sle.; 4 1/2" depth system.
   2. Tubelite, Inc. VersaTherm: www.tubeliteinc.com; 3 1/2" depth system.
   3. Substitutions: See Section 016000 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Thermally-Broken:

B. Front-Set Style, Thermally-Broken:

C. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.03 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Satndard Painted - 70% PVDF: Slate Gray WP LT604-70..
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.04 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.

B. Glazing: See Section 088000.

C. Swing Doors: Glazed aluminum.
   1. Thickness: 1-3/4 inches (43 mm).
   2. Style: wide as indicated on the drawings.
   3. Glazing Stops: Square.
   4. Finish: Same as storefront.

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

D. Glazing Accessories: See Section 088000.

2.06 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 087100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all exterior doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

F. Hinges: Butt type, swing clear; top, intermediate, and bottom.

G. Push/Pull Set: Standard configuration push/pull handles.

H. Exit Devices: Panic type.
   1. Provide on doors as indicated.

I. Door Closers: Concealed overhead.

J. Locks: Dead latch with turn handle inside .

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 088000.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for general testing and inspection requirements.

B. Water-Spray Test: Provide water spray quality test of installed storefront 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.

C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Cabinets (casework), including locks in cabinets

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. '081113 'Metal Doors and Frames"
   b. "081416 Flush Wood Doors"
   c. "084313 Aluminum-Framed Entrances and Storefronts"
   d. "083200 Sliding Glass Doors"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

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

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code

2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:
    1) Door Index: door number, heading number, and Architect's hardware set number.
    2) Quantity, type, style, function, size, and finish of each hardware item.
    3) Name and manufacturer of each item.
    4) Fastenings and other pertinent information.
    5) Location of each hardware set cross-referenced to indications on Drawings.
    6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    7) Mounting locations for hardware.
    8) Door and frame sizes and materials.
    9) Degree of door swing and handing.
    10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Final approved hardware schedule edited to reflect conditions as installed.
    d. Final keying schedule
    e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
    f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
    a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
    a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
        1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
        2) Preliminary key system schematic diagram.
        3) Requirements for key control system.
        4) Requirements for access control.
        5) Address for delivery of keys.

2. Pre-installation Conference
    a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Inspect and discuss preparatory work performed by other trades.
    c. Inspect and discuss electrical roughing-in for electrified door hardware.
    d. Review sequence of operation for each type of electrified door hardware.
    e. Review required testing, inspecting, and certifying procedures.
    f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
    a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage ND Series: 10 years
        2) Exit Devices
            a) Von Duprin: 10 years
        3) Closers
            a) LCN 4000 Series: 30 years
        4) Automatic Operators
            a) LCN: 2 years
    b. Electrical Warranty
        1) Locks
            a) Schlage: 3 years
        2) Exit Devices
            a) Von Duprin: 3 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

   1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

   1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
   2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

   1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

   1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
   2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
   3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
   b. Hager

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.

6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.

2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
   a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
   b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
   c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
   d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
   e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
   b. Lever Design: LATITUDE (LAT)

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Special Options:
    a. SI
        1) Provide dogging indicators for visible indication of dogging status.
    b. XP
        1) Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds.
    c. QM
        1) Rim Exit Devices: provide devices with damper-controlled re-latching to reduce operational noise. Where lever trim is specified, provide damper controlled lever return.
    d. CVC
        1) Provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods not permitted.
            a) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
            b) Wood Door Prep: Maximum 1 inch x 1.1875 inch x 3.875 inches top latch pocket and 1 inch x 1.1875 inch x 5 inches bottom latch pocket which does not require the use of a metal wrap or edge for non-rated or fire rated wood doors up to a 45 minute rating.
            c) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
            d) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90-degree engagement with strike to prevent door and frame separation under high static load.

e) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
f) Product Cycle Life: 1,000,000 cycles.
g) Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
h) Latch release does not require separate trigger mechanism.
i) Cable and latching system characteristics:
    i. Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
    ii. Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
    iii. Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging
    iv. Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment. Bottom latch deadlocks in every adjustment position in wood doors.
    v. Top and bottom latches in steel and aluminum doors and top latch in wood doors may be removed while door is hanging.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
    a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
    a. No Substitute

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
    a. 12/24 VDC Output, field selectable.
    b. Class 2 Rated power limited output.
    c. Universal 120-240 VAC input.
    d. Low voltage DC, regulated and filtered.
    e. Polarized connector for distribution boards.
    f. Fused primary input.
    g. AC input and DC output monitoring circuit w/LED indicators.
    h. Cover mounted AC Input indication.
    i. Tested and certified to meet UL294.
    j. NEMA 1 enclosure.
    k. Hinged cover w/lock down screws.
    l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Schlage FSIC

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.12 KEYING

A. Scheduled System:

1. New factory registered system:
   a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Temporary Construction Cylinder Keying.
      1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
         a) Split Key or Lost Ball Construction Keying System.
         b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
         c) 12 construction change (day) keys.
      2) Owner or Owner's Representative will void operation of temporary construction keys.
   b. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative with assistance from the General Contractor will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
      3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.

d. Identification:
   1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
   2) Identification stamping provisions must be approved by the Architect and Owner.
   3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
   4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
   5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
e. Quantity: Furnish in the following quantities.
   1) Permanent Control Keys: 3.
   2) Master Keys: 6.
   3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
   4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers:
   a. HPC
   b. Lund

B. Requirements:

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

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certified closers. Stamp units with date of manufacture code.

2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. No Substitute

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumb turn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

B. Scheduled Manufacturer:

1. Zero International

C. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
   a. Provide non-corrosive fasteners for all exterior applications.
   b. Provide security fasteners where indicated.

D. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for smoke control ratings indicated based on testing according to UL 1784.

E. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.

F. Meeting-Stile Gasketing: Where indicated, provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.

G. Door Sweeps or Shoes: Where indicated, apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

H. Rain Drips:

1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
2. Door sweeps or shoes with integral rain drip must meet ADA requirements

I. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

2. Acceptable Manufacturers:
   a. GE-Interlogix
   b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.

2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.22 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Provide coat hooks as specified.

2.23 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.

3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds:

1. Set thresholds in full bed of sealant and grout complying with requirements specified in Division 07 Section "Joint Sealants."
2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing:

1. Apply to head and jamb, forming seal between door and frame.
2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Legend:
Link to catalog cut sheet
Electrified Opening

Hardware Group No. 01

For use on Door #(s):
005

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5			652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8			652	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	OH STOP	90S			689	GLY
1	EA	SURFACE CLOSER	4040XP TBWMS			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
3	EA	SILENCER	SR64			GRY	IVE
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. 02

For use on Door #(s):
116

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 CON TW8			652	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBWMS			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
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. 03

For use on Door #(s):
120

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	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-L-NL-LAT-CON 24 VDC		626	VON
1	EA	FSIC RIM CYLINDER W/CONSTRUCTION CORE	AS REQUIRED		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED			SCH
1	EA	MULTITECH READER	MTB11 / MTB15		BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED		628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 04.1

For use on Door #(s):
148

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	LOCK GUARD	LG12			630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	RAIN DRIP	142AA			AA	ZER
1	SET	GASKETING	429AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION			A	ZER
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 05

For use on Door #(s):
174 181

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5			652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8			652	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	SURFACE CLOSER	4040XP TBWMS			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
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. 06

For use on Door #(s):
199

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	LOCK GUARD	LG12		630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION		A	ZER
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED			SCH
1	EA	MULTITECH READER	MTB11 / MTB15		BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED		628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 07

For use on Door #(s):
204

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	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-98-L-NL-F-LAT-CON 24 VDC			626	VON
1	EA	FSIC RIM CYLINDER W/CONSTRUCTION CORE	AS REQUIRED			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	SET GASKETING	488SBK			BK	ZER
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 08

For use on Door #(s):
003 121 202

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	FIRE EXIT HARDWARE	98-L-BE-F-LAT		626	VON
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	SET GASKETING	488SBK		BK	ZER

Hardware Group No. 09

For use on Door #(s):
007

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	HINGE	5BB1HW 5 X 4.5			652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 5 X 4.5 CON TW8			652	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	SURFACE CLOSER	4040XP TBWMS			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
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. 10

For use on Door #(s):
006 008 179A 183A 194

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP TBWMS		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. 11

For use on Door #(s):
020 021

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	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S LAT OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	SET GASKETING	488SBK		BK	ZER
1	EA	COAT AND HAT HOOK	582		626	IVE

Hardware Group No. 12

For use on Door #(s):
022 023 172 173

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 6" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP TBWMS		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. 13

For use on Door #(s):
024 025 117 118 176 178
195 196

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S LAT OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	SET GASKETING	488SBK		BK	ZER
1	EA	COAT AND HAT HOOK	582		626	IVE

Hardware Group No. 14

For use on Door #(s):

104	106	107	108	109	110
111	112	113	114	115	126
133	134	135	141	152	158
159	164	175	177	186	

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 15

For use on Door #(s):

125	140

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	CLASSROOM LOCK	ND70TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		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. 16

For use on Door #(s):

197

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	STOREROOM LOCK	ND80TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 16.1

For use on Door #(s):
198

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 CON TW8			652	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
3	EA	SILENCER	SR64			GRY	IVE
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. 17

For use on Door #(s):
183B

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	STOREROOM LOCK	ND80TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		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. 18

For use on Door #(s):
119 182 185 193

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S LAT		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 19

For use on Door #(s):
301

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	ND80TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	LOCK GUARD	LG12		630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION		A	ZER
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED		628	SCE

Hardware Group No. 20

For use on Door #(s):
192

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	ENTRANCE/OFFICE LOCK	ND50TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	SET GASKETING	488SBK		BK	ZER

Hardware Group No. 21

For use on Door #(s):
016

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED		626	IVE
1	EA	STOREROOM LOCK	ND80TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 22

For use on Door #(s):
179B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED		626	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC	✓	626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
2	EA	MOUNTING BRACKET	MB1/MB2		SP28	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43STST		STST	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION		A	ZER
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED	✓		SCH
1	EA	MULTITECH READER	MTB11 / MTB15	✓	BLK	SCE
2	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED	✓	628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC	✓		VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY UNLOCKS LEVER TO ALLOW ENTRY OR BY KEY.
INSIDE LEVER ALWAYS ALLOWS EGRESS.

Hardware Group No. AL01

For use on Door #(s):
009 015B 018 102B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	112XY EPT			628	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON 24 VDC			626	VON
1	EA	FSIC RIM CYLINDER W/CONSTRUCTION CORE	AS REQUIRED			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
1	EA	OH STOP	100S			630	GLY
1	EA	SURFACE CLOSER	4040XP EDA TBWMS			689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA			689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30			689	LCN
1	EA	BLADE STOP SPACER	4040XP-61			689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION			A	ZER
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL02.1

For use on Door #(s):
102A 103 123

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU LAT CON 12V/24V DC		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			
2	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED			SCH
1	EA	MULTITECH READER	MTB11 / MTB15		BLK	SCE
1	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED		628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LEVER TO ALLOW ENTRY OR BY KEY.
ALWAYS ALLOWS EGRESS.

Hardware Group No. AL03

For use on Door #(s):
019

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	CLASSROOM LOCK	ND70TD LAT		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP TBWMS		689	LCN
1	EA	MOUNTING PLATE	4040XP-18		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL04

For use on Door #(s):
100A 101

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	112XY EPT			628	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9847-EO-CON 24 VDC			626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9847-NL-OP-110MD-CON 24 VDC			626	VON
1	EA	FSIC RIM CYLINDER W/CONSTRUCTION CORE	AS REQUIRED			626	SCH
1	EA	FSIC CORE	AS REQUIRED			626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
2	EA	OH STOP	100S			630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBWMS			689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA			689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30			689	LCN
2	EA	BLADE STOP SPACER	4040XP-61			689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	VERIFY SILL CONDITION			A	ZER
4	EA	WIRE HARNESS	CON-XX LENGTH AS REQUIRED				SCH
1	EA	MULTITECH READER	MTB11 / MTB15			BLK	SCE
2	EA	DOOR CONTACT	7764 / 679-05 AS REQUIRED			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL-FA 900-BBK 120/240 VAC				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL05.1

For use on Door #(s):
015A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
2	EA	HEADER / THRESHOLD BOLT	4015 x 4085		628	ADA
1	EA	EXIT INDICATOR	4089		626	ADA
1	EA	MORTISE LOCK	MS1850S x 4590 DEADLATCH PADDLE		626	ADA
1	EA	FSIC MORTISE CYLINDER	AS REQUIRED		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH
2	EA	PUSH/PULL BAR	9190HD-10"		630	IVE
2	EA	OH STOP	100S		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL06

For use on Door #(s):
100B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
2	EA	DUMMY PUSH BAR	350		626	VON
2	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
2	EA	OH STOP	100S		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. SL01

For use on Door #(s):

010	011	012	013	014	127
128	129	130	131	132	137
138	139	142	143	144	145
146	147	150	151	153	154
155	156	157	161	162	163
165	166	167	168	169	170
187	188	189	190		

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	SLIDING DOOR HW	BY MANUFACTURER			KAW
1	EA	FSIC MORTISE CYLINDER	AS REQUIRED		626	SCH
1	EA	FSIC CORE	AS REQUIRED		626	SCH

END OF SECTION

SECTION 088000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing units.

B. Plastic films.

1.02 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

B. Section 083200 - Sliding Glass Doors: Glazing.

C. Section 084313 - Aluminum-Framed Storefronts: Glazing.

D. Section 102800 - Toilet, Bath, and Laundry Accessories: Mirrors.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C1036 - Standard Specification for Flat Glass; 2021.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

G. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

I. GANA (GM) - GANA Glazing Manual; 2022.

J. GANA (SM) - GANA Sealant Manual; 2008.

K. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.

L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

N. ITS (DIR) - Directory of Listed Products; Current Edition.

O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Samples: Submit two samples 12 by 12 inch (___ by ___ mm) in size of glass units.

D. Samples: Submit up to 3 separate sample submittals of architectural designed pattern image on film in 24" x 24" sizes.

E. Certificate: Certify that products of this section meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.06 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
   1. GGI - General Glass International: www.generalglass.com/#sle.
   2. Guardian Glass.
   3. Standard Bent Glass Corp: www.standardbent.com/#sle.
   4. Tecnoglass; Insulating Glass: www.tecnoglass.com/#sle.
   5. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   6. Viracon, Inc: www.viracon.com/#sle.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Mirrored Glass Manufacturers:
   1. Pilkington North America Inc: www.pilkington.com/na/#sle.
   2. Saint Gobain North America; Saint Gobain Miralite Revolution: www.saint-gobain.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

C. Plastic Films Manufacturers:
   1. Solyx iQ SUPER CLEAR SR Polyester, www.decorativefilms.com.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   4. Patterned Glass Type: ASTM C1036, Type II - Patterned Flat Glass, Form 3 - Patterned glass, with color and performance characteristics as indicated.
   5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.03 INSULATING GLASS UNITS

A. Manufacturers (Basis of Design):
   1. Guardian Glass, LLC; SN68: www.guardianglass.com/#sle.
      a. Overall Unit Thickness: 1 inch.

b. Minimum Thickenss of Each Glass Lite: 1/4 inch.
c. Outdoor Lite; Mirrored HS (heat-strengthened) float glass, except provide FT (fully tempered) where required by code for safety glazing. Or Mirrored Spandrel Glass as indicated on the drawings.
    1) Tint Color: To be selected from manufacturers standards
d. Interspace Content: Argon.
e. Indoor Lite: Clear annealed float glass, except provide FT *fully tempered) where requried by code for safety glazing.
f. Low-E Coating: Sputtered on second surface.
g. U-Value of 0.245 (winter) and 0.22 (summer).
h. SHGC value of 0.43.

2. Substitutions: See Section 016000 - Product Requirements.

2.04 GLAZING UNITS

A. Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Annealed float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch (6.4 mm), nominal.

B. Type G-3 - Monolithic Safety Glazing: Non-fire-rated.
1. Applications:
    a. Glazed lites in doors and window frames on the building interior, except fire doors.
    b. Sliding glass doors.
    c. Other locations required by applicable federal, state, and local codes and regulations.
    d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch (6.4 mm), nominal.

2.05 PLASTIC FILMS

A. Plastic Film: Polyester type.
1. Application: Locations as indicated on drawings.
2. Surface Burning Characteristics: Flame Spread Index (FSI)/Smoke Developed Index (SDI) of Class A, 25/450, maximum, when tested in accordance with ASTM E84.
3. Tensile Strength: Minimum of 32,000 psi (221 MPa) when measured in accordance with ASTM D882.
4. Color: Clear.
5. Thickness Without Liner: 0.002 inch (0.051 mm).

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Verify that sealing between joints of glass framing members has been completed effectively.

D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry prior to film installation. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.

B. Place without air bubbles, creases or visible distortion.

C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.05 FIELD QUALITY CONTROL

A. Glass, Glazing, and plastic film product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 088300
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: installation of mirrors on framed gypsum board walls.

B. Section 093000 - Tiling: coordination of mirror installation with wall tile.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

D. GANA (GM) - GANA Glazing Manual; 2022.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

1.05 QUALITY ASSURANCE

A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mirrors:
   1. As listed on the drawings.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Size: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 089100
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-In-Place Concrete: Installation fo louvers in formed concrete walls.

B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

C. Section 092116 - Gypsum Board Assemblies: Installation of louvers in exterior framed walls.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

D. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

E. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

C. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior surfaces.

D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers:
   1. Airolite Company, LLC: www.airolite.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.

B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with intermediate mullions matching frame.
   1. Free Area: 56 percent, minimum.
   2. Pressure Drop: 0.073 inch wg maximum per square foot (square meter) of free area at velocity of ____ fpm (____ m/s), when tested in accordance with AMCA 500-L, test unit size 48 inch by 48 inch (1.22 m by 1.22 m).
   3. Blades: Straight.
   4. Frame: 4 inches deep (100 mm deep), channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
   5. Steel Thickness, Galvanized: Frame 16 gauge, 0.0598 inch (1.52 mm) minimum base metal; blades 16 gauge, 0.0598 inch (1.52 mm) minimum base metal.
   6. Steel Finish: Superior performing organic coating, finished after fabrication.
      a. Color: to be selected from manufacturers standard colors.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), ____ alloy, ____ temper.

2.04 FINISHES

A. Kynar/Fluoropolymer Coating, 3-coat 70% Kynar paint/100% Fluoropolymer.

2.05 ACCESSORIES

A. Bird Screen: Interwoven wire mesh of steel, 14 gauge, 0.0641 inch (1.63 mm) diameter wire, 1/2 inch (13 mm) open weave, diagonal design.

B. Insect Screen: 18 x 16 size aluminum mesh.

C. Fasteners and Anchors: Galvanized steel.

D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

E. Head and Sill Flashings: See of same material as louver frame..

F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Coordinate with installation of flashings by others.

C. Install louvers level and plumb.

D. Set sill members and sill flashing in continuous bead of sealant.

E. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

F. Secure louver frames in openings with concealed fasteners.

3.03 ADJUSTING

A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.04 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION

DIVISION

9

FINISHES

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Resilient sound isolation clips.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

G. Textured finish system.

1.02 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.

B. Section 061000 - Rough Carpentry: Building framing and sheathing and weather barrier.

C. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

D. Section 072100 - Thermal Insulation: Perimeter exterior wall insulation.

E. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

F. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

G. Section 099123 - Interior Painting: coordination of backrolled texture finish.

1.03 REFERENCE STANDARDS

A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).

F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

J. 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.

K. 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.

L. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

M. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.

N. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

O. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.

P. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).

Q. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

S. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

T. ASTM E413 - Classification for Rating Sound Insulation; 2022.

U. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

V. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

W. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

X. UL (DIR) - Online Certifications Directory; Current Edition.

Y. UL (FRD) - Fire Resistance Directory; Current Edition.

Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Sequencing: Install service utilities in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, indicating finish color and texture.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code. and as detailed on the drawings.
   1. Fire-Resistance-Rated walls and ceilings: One (1) hour fire rating.

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

C. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Jaimes Industries: www.jaimesind.com/#sle.
   4. MarinoWARE: www.marinoware.com/#sle.
   5. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
   6. R-stud: www.rstud.com/#sle.
   7. SCAFCO Corporation: www.scafco.com/#sle.
   8. Steel Construction Systems: www.steelconsystems.com/#sle.
   9. Telling Industries: www.tellingindustries.com/#sle.
   10. Substitutions: See Section 016000 - Product Requirements.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling/Soffit Channels: as indicated on the drawings.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   5. Furring Members: Zee-shaped sections, minimum depth of 2 inch (_____ mm).

E. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
   5. PABCO Gypsum: www.pabcogypsum.com/#sle.
   6. USG Corporation: www.usg.com/#sle.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required as indicated on the drawings.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).

b. Ceilings: 5/8 inch (16 mm).
c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Impact Resistant Wallboard:
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
5. Type: Fire-resistance-rated Type X, UL or WH listed.
6. Thickness: 5/8 inch (16 mm).
7. Edges: Tapered.

D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 5/8 inch (___ mm).
3. Edges: Tapered.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.

B. Fire and Sound Attenuating Insulation: Sprayed cellulose fire-rated material for cavities in wall assemblies.
1. Surface Burning Characteristics: Provide assemblies with Class I rating, when tested in accordance with ASTM E84.
2. Sound Transmission Class (STC): 56, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
2. Tape Thickness: 1/4 inch (6 mm).

D. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
1. Products:
a. Franklin International, Inc: www.titebond.com/#sle.
b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
c. Specified Technologies Inc: www.stifirestop.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

E. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
2. Expansion Joints:
a. Type: V-shaped metal with factory-installed protective tape.

F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Joint Compound: Drying type, vinyl-based, ready-mixed.

G. Finishing Compound: Surface coat and primer, takes the place of skim coating.

H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure in all locations.
   2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

F. Resilient Sound Isolation Clips: Install resilient sound isolation clips, and where applicable, associated furring sections and channels, in accordance with clip manufacturer's written instructions.

G. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.

H. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.
   7. Owner-provided equipment.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
   2. At exterior soffits, not more than 30 feet (10 meters) apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

C. Spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.07 TEXTURE FINISH

A. Texture Required: painted back-roll texture as indicated on the drawings.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.09 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean all surfaces in preparation for finish painting.

3.10 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 093000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Tile for stairs.

D. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-In-Place Concrete: installation on concrete deck/floors.

B. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

C. Section 092116 - Gypsum Board Assemblies: Installation on framed walls.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

C. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

D. 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).

E. 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.

F. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

G. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

H. ANSI A137.3 - American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs; 2021.

I. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

J. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. 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.

D. Installer's Qualification Statement:

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than one box of each type.

1.05 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:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 MOCK-UPS

A. See Section 014000 - 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. Approved mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 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

2.01 TILE

A. Manufacturers: as indicated on the drawings .
   1. Marazzi as indicated on the drawings.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: as indicated on the drawings, style and dimensions to suit application, set with tile mortar or adhesive.
   1. Applications as indicated on the drawings:
      a. Open edges of wall and floor tile.
      b. Inside and outside wall corners.
      c. Transition between floor finishes of different heights.
      d. Thresholds at door openings.
   2. Products:
      a. Schluter-Systems; Schiene: www.schluter.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
   1. Products:
      a. Custom Grout Solutions; Fusion Pro, Commercial 100% Solids Epoxy Grout.
      b. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:

1. Custom Grout Solutions; Fusion Pro, Commercial 100% Solids Epoxy Grout.
2. Substitutions: See Section 016000 - Product Requirements.

C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Color(s): As indicated on drawings.

2.05 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.

B. Tile Underlayment: Specifically designed for bonding to thin-set setting mortar; not primarily waterproofing material and having the following characteristics:
1. Crack Resistance: No failure at 1/16-inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
2. Suitable for installation over green concrete

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION - GENERAL

A. Install tile and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.

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. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated.

L. 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.

3.04 CLEANING

A. Clean tile and grout surfaces.

3.05 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100
ACOUSTICAL CEILINGS - USG

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling systems.

B. Acoustical units.

C. Wall angles and shadow moldings.

D. Special trims and accessories.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Acoustical insulation.

B. Mechanical Divisions: HVAC and Fire Protection coordination.

C. Electrical Divisions: light fixture coordination.

1.03 REFERENCE STANDARDS

A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

F. ITS (DIR) - Directory of Listed Products; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.

1. Review with affected installers those locations of facility services lines and equipment within ceiling plenum that prevent installation of hangers at spacings compliant with limitations established in referenced standards. Arrange for each affected mechanical or electrical installer to provide necessary number of additional structural support points for ceiling installer.

B. Sequencing: Schedule work of affected trades to minimize or eliminate installation conflicts and rework.

1. Ensure that 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. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Two samples 4 by 4 inches (_____ by _____ mm) in size indicating material and finish of acoustical units.

D. Samples: Two samples each, 12 inches (____ mm) long of suspension system main runner, cross runner, and perimeter molding.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements for additional provisions.

2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

PART 2 PRODUCTS

2.01 CEILING ASSEMBLIES

A. Refer to Room Finish Schedule and Reflected Ceiling Plans on drawings for additional ceiling assembly information.

B. Acoustical Ceiling Assembly Type _____:
   1. Acoustical Units: Orion 60 1/2".
      a. Panel Size: 24 inches by 48 inches (2 by 4) panel (609.6 mm by 1219.2 mm).
      b. Panel Edge: FLB edge.
      c. Color: Flat White.
   2. Suspension Grid: Donn Fineline DXF Suspension System.
      a. Color: Reserve white.

2.02 CEILING PERFORMANCE REQUIREMENTS

A. Design for maximum deflection of 1/360 of span.

2.03 CEILING COMPONENT PRODUCTS

A. Acoustical Units:
   1. Acoustical Units - General: ASTM E1264, Fire Class A.
      a. Noise Reduction Coefficient (NRC) rating, Ceiling Attenuation Class (CAC) rating, and Light Reflectance Coefficient (LR) performance for each type of unit specified below, as determined in accordance with ASTM E1264.
      b. Fire Class / Surface Burning Characteristics: Determined in accordance with test method ASTM E84.
   2. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
      a. Classification: ASTM E1264 Type A - Mineral Base; Form A2 - with membrane-faced overlay.
      b. Products:
         1) USG Corporation; Orion 60 1/2" Panels: www.usg.com/ceilings/#sle.

B. Suspension Systems:
   1. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with wall angles and moldings, perimeter trim, curtain pockets, and splices as required.
   2. Exposed Acoustical Suspension System: Hot-dipped galvanized steel grid.
      a. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
      b. Profile: Slotted Reveal Tee; 9/16 inch (14 mm) face width, with 1/4 inch (6.35 mm) wide center reveal.
      c. Color: Flat White 050.
      d. Products:
         1) USG Corporation Fineline DXF Suspension System: www.usg.com/ceilings/#sle.

C. Moldings and Trim:
   1. Edge Molding, Expansion Joints, and Splices - General: Same material, thickness, and finish as metal pan panels, unless otherwise indicated.
   2. Perimeter Wall Moldings: Same metal and finish as grid.
      a. Size: As required for installation conditions.
      b. Acoustical Sealant For Perimeter Moldings: Nonhardening, nonskinning, for use in conjunction with suspended ceiling system.
   3. Trim Accessories: Manufacturer's standard clips, cleats splice plates, extension plates, closure plates, corner pieces, and similar accessories required for a complete installation.

2.04 ACCESSORIES

A. Support Channels, Carriers, and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Suspension Wire: Size and type as required for application and ceiling system flatness requirement specified.
   1. Concealed Suspension:
      a. Suspension Wire: Steel, annealed, galvanized finish, 12 gauge, 0.0808 (2.05 mm) diameter, complying with ASTM A641/A641M.

C. Touch-Up Paint for Exposed Surfaces: Type and color to match acoustical units and suspension system grid and trim elements.

D. Touch-Up Paint For Concealed Items: Zinc rich type, as recommended by ceiling system manufacturer.

2.05 FABRICATION

A. Shop fabricate ceiling components to the greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Verify that field measurements are as indicated.

D. Start of installation constitutes acceptance of project conditions.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Install ceiling system after major above-ceiling work is complete.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M and manufacturer's instructions and as supplemented in this section.

B. Install hangers and inserts coordinated with overhead work. Provide additional hangers and supports as required.

C. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

D. Suspension System, Nonseismic: 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.

E. Where ducts, facility services, or equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Edge Moldings: Install at intersection of ceiling and vertical surfaces and penetrations, using components of maximum length; set level. Provide edge moldings at junction with other ceiling finishes. Miter corners. Provide preformed edge closures to match bullnosed cornered partitions.
   1. Use longest practical lengths.

3.04 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. Fit edge trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.05 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: Two degrees.

3.06 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

SECTION 095426
SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood veneer panels.

B. Linear wood planks.

C. Metal suspension system.

1.02 RELATED REQUIREMENTS

A. Mechanical Division: Integration of mechanical items in ceiling.

B. Electrical Divisions: Integration of electrical items in ceiling.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

C. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on wood ceiling components and suspension system components.

C. Samples: Submit two samples each, 12 inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least ten years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Ceilings:
   1. Armstrong World Industries, Inc; Woodworks: www.armstrongceilings.com/#sle.
      a. Grille - Forte Ceiling Panels, 6324L S04

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:
   1. Design for maximum deflection of 1/360 of span.

B. Wood Veneer Panels: wood core with wood veneer finish.
   1. Classification: ASTM E1264, Class A.
   2. Panel Size: 24 by 96 inches (_____ by _____ mm).

3. Panel/Plank Thickness: 3/4 inch (19 mm).
4. Veneer Species: poplar.
    a. Veneer Cut: Plain sliced.
    b. Veneer Matching: Random matched.
    c. End Matching: Manufacturer's recommended matching.
    d. Factory Finish: Red Oak (GRK) on Poplar.

C. Metal Suspension System:
1. Type as recommended by manufacturer.
2. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement.

D. Accessories: Manufacturer's standard accessories for installation method indicated, above-ceiling accessibility.

2.03 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

C. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Wood Ceiling:
1. Install wood ceilings in accordance with manufacturer's instructions.
2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
3. Install components in uniform plane, and free from twist, warp, and dents.
4. Cut to fit irregular grid and perimeter edge trim.
5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

3.05 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.

D. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2021).

E. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.

F. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

G. ASTM F3261 - Standard Specification for Resilient Flooring in Modular Format with Rigid Polymeric Core; 2020.

H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements 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. Verification Samples: Submit two samples, 12 by 12 inch (___ by ___ mm) in size illustrating color and pattern for each resilient flooring product specified.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Floor Material: 5% of installed amount.
   3. Extra Wall Base Material: 5% of installed amount.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.

1.06 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. Protect roll materials from damage by storing on end.

1.07 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

2.01 TILE FLOORING

A. Vinyl Tile: Surface-decorated, with wear layer.
   1. Manufacturers:
      a. Mannington Commercial; Spacia Collection, Wood Style
   2. Total Thickness: .197 inch (____ mm).
   3. Pattern: as indicated on the drawings..
   4. Color: As indicated on drawings.

2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; style as scheduled.
   1. Manufacturers:
      a. Johnsonite.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Height: 2-1/2 inches (62 mm) and 4 inches.
   3. Thickness: 0.250 inch (6.4 mm) (monument profile).
   4. Length: 10 or 12 foot (1.2 m) sections.
   5. Color: As indicated on drawings.

2.03 ACCESSORIES

A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring and/or base manufacturer.

B. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 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 wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 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. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

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

C. Loose-Laid Installation: Set flooring in place in accordance with manufacturer's instructions.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 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.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096566
RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composition rubber resilient laminated sheet flooring, adhesively installed.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 REFERENCE STANDARDS

A. ASTM F2772 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems; 2011 (Reapproved 2019).

B. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification; 2006.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Verification Samples: Actual flooring material specified, not less than 6 inch (____ mm) square, mounted on solid backing.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Materials: 1% of installed product.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 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.

1.06 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F (21 to 35 degrees C) for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F (10 degrees C) or to go above 100 degrees F (38 degrees C).

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

A. Manufacturers: All products by the same manufacturer.
   1. ECO Surfaces; ECOfit Rolls
      a. 3.2 + 5mm Rolls Vulcanized Compoition Rubber Fusion Bonded Resilient Flooring
      b. Tensile Strength: 200 psi; ASTM D 412, die C
      c. Flexibility: Pass; ASTM F 137
      d. Thermal Conductivity: 0.10 Btu-in/hr-ft(2)-F; ASTM C 518
      e. Recovery After Static Load: 0.004"; ASTM F 970
      f. Coefficient of Friction: > 0.8; ASTM D 2047
      g. FloorScore: Pass; CA 01350
      h. Resistance to Light: Good; ASTM F 1515
      i. Chemical Resistance: Good, No Change; ASTM F 925
      j. Abrasion Resistance: Pass; ASTM D 3389
      k. Sheet Dimension: 4 ft wide

l. Standard Tolerance Width: + 3/4" - 0"
m. Standard Tolerance Length: + 1% - 0"
n. Sandard Tolerance Thickness: +/- .6mm

2. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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 athletic flooring to substrate.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

C. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

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

C. Resilient Sheet Flooring:
1. Unroll flooring and allow to relax before beginning installation.
2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
5. Weld seams using techniques and equipment recommended by manufacturer.
6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.04 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 096813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Walk-Off Carpet, fully adhered.

C. Matching roll carpet for direct glue installation on base, stairs, and _____.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical characteristics; sizes, patterns, colors available, and method of installation.

C. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 2 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum five years documented experience and approved by carpet tile manufacturer.

1.05 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. ShawContract.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Tile Carpeting, Type standard interior office spaces: _____, manufactured in one color dye lot.
   1. Product: Cultura, Cross Weave Tile manufactured by ShawContract.
   2. Tile Size: 18 inches by 36 inches inch (____by____ mm), nominal.
   3. Thickness: 0.107 inch (____ mm).
   4. Gauge: 1/12 inch (____ mm).
   5. Stitches: 9.0 per inch (____ per cm).
   6. Tufted Weight: 18 oz/sq yd
   7. Total Thickness: 0.277 inch
   8. ADA compliant.
   9. Rating: Class 1
   10. NBS Smoke: Less than 450
   11. Wear Rating: Severe; ASTM D5252

B. Walk-Off Carpeting: Type (entrances), manufactured in one color dye lot.
   1. Product: All Access, Swift Tile manufactured by ShawContract.
   2. Tile Size: 24 inches by 24 inches, nominal.
   3. Thickness: 0.123 inch
   4. Gauge: 1/12 inch
   5. Stitches: 9.0 per inch
   6. Tufted Weight: 28 oz/ sq yd
   7. Total Thickness: 0.270 inch
   8. ADA compliant.
   9. Rating: Class 1
   10. NBS Smoke: Less than 450
   11. Wear Rating: Severe; ASTM D5252

C. Roll Carpet: Same manufacturer, type, color and pattern, and face fiber characteristics as carpet tile, ____ feet (____ m) wide, manufactured in same color dye lot as tile.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, _____ color.

C. Adhesives:

D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet 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 carpet tile.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in _____ pattern indicated with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 INSTALLATION ON STAIRS

A. Use one piece of carpet for each tread and the riser below. Apply seam adhesive to all cut edges.

B. Lay carpet with pile direction in the length of the stair.

C. Adhere carpet tight to stair treads and risers.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound-absorbing panels.

B. Mounting accessories.

1.02 RELATED REQUIREMENTS

A. Section 053100 Steel Decking: attachment of sound panels to steel decking.

B. Section 099123 - Interior Painting: field painting of acoustical units and attachments.

1.03 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023, with Editorial Revision (2024).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, panel layout.

D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

B. Store units flat, in dry, well-ventilated space; do not stand on end.

C. Protect edges from damage.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:
   1. Tectum by Armstrong World Industries, Inc.: Product: "Finale" Direct-Attached Interiro Ceiling Panels.
   2. Substitutions: See Section 016000 - Product Requirements.

B. General:
   1. Cementitious Wood Fiber Plank Acoustical Ceiling Panels:
      a. High-impact textured wood fiber panels bonded with inorganic hydraulic cement.
      b. Surface Burning Characteristics: Flame spread inde of 0 or less with smoke development index of 0, when tested in accordance with ASTM E84.
      c. Panel Size: standard 4' x 8' sheets, cut a needed to provide layout shown in drawings.
      d. Panel Thickness: 2 inches.
      e. NRC (Noise Reduction Coefficient): ASTM C423; 1.0

f. Corners: Square, typical.
g. Mounting: Direct attach.
h. Color: White or natural, but will be painted in the field.
i. Locations: Ceiling / Bottom of Deck Mounted as shown in the drawings.

2.02 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal:
   1. Metal impaling clips designed to support full weight of panels, mechanically attached to substrate and adhesively bonded to back of panels.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Install mounting accessories and supports in accordance with shop drawings.

C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

D. Install acoustical units to construction tolerances of plus or minus 1/16 inch (1.6 mm) for the following:
   1. Plumb and level.
   2. Flatness.
   3. Width of joints.

3.03 CLEANING

A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 099113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Items as indicated on the drawings.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically indicated.
   9. Ceramic and other types of tiles.
   10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   11. Glass.
   12. Concealed and exposed pipes, ducts, and conduits.
   13. Metal wall panels or trim.
   14. Pre-finished architectural wall louvers.
   15. Pre-finished metal sun shades.
   16. Exterior wood items to recieve stain.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting.

B. Section 099300 - Staining and Transparent Finishes: exterior wood items for staining.

C. Section 099600 - High-Performance Coatings: exterior steel items for powder coat finish.

1.03 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

D. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1; 2024.

E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

F. SSPC-SP 2 - Hand Tool Cleaning; 2024.

G. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood doors, and stains, floorcoverings, etc., have been approved.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.06 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, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature 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.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Provide paints and finishes from the same manufacturer.
   1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

C. Paints:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - EXTERIOR

A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including wood soffits.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Latex.
      a. Products:
         1) Sherwin-Williams SuperPaint Exterior.
         2) Substitutions: See Section 016000 - Product Requirements

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Alkali-Resistant Water-Based Primer.
      a. Products:
         1) Sherwin-Williams Loxon Water Blocking Primer/Finish.
         2) Substitutions: See Section 016000 - Product Requirements

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Sand metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Materials for backpriming woodwork.

D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Elevator pit ladders.
   3. Mechanical and Electrical:
      a. In all areas, do NOT paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In all areas, paint shop-primed items and all items mounted within a painted gypsum board wall.
      c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

E. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.
   12. Wood trim to recieve stain unless indicated.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Pay special attention to paint backroll note in drawings for the interior drywall finish.

B. Section 099113 - Exterior Painting.

C. Section 09300 - Staining and Transparent Finishing: finishing of wood trim.

D. Section 099600 - High-Performance Coatings.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

C. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1; 2024.

D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

E. SSPC-SP 2 - Hand Tool Cleaning; 2024.

F. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. Cross-reference to specified paint system products to be used in project; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood cabinets, wood doors, and wood stain, floorcoverings, etc., have been approved.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gal (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.07 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, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature 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.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.

D. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, uncoated steel, shop primed steel, galvanized steel, aluminum, and hollow metal doors and frames, sound-absorbing acoustical panels, steel decking, steel guardrails and handrails, ductwork, conduit, and other misc. items..
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex.
      a. Products:
         1) Sherwin-Williams ProMar 200 HP Series
         2) Substitutions: See Section 016000 - Product Requirements

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Alkali Resistant Water Based Primer.
      a. Products:
         1) Sherwin-Williams Loxon Water Blocking Primer/Finish.
         2) Substitutions: See Section 016000 - Product Requirements

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Etch ductwork and other items as necessary for proper bonding.

D. Remove or repair existing paints or finishes that exhibit surface defects.

E. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

F. Seal surfaces that might cause bleed through or staining of topcoat.

G. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

I. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

K. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

L. Metal Doors and Frames to be Painted: Prime metal door top and bottom edge surfaces.

M. Sound- Absorbing Wall and Ceiling Units: Application amount may need to increase for proper coverage.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Sand metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Wood to Receive Transparent Finishes: See Section 099300.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 099300
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field application of stains.

1.02 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Stains and finishes wood ceilings and wood trim.

B. Section 060573 - Wood Treatment: installation of field applied fire treatment prior to staining of exterior wood soffits and canopies.

C. Section 081416 - Flush Wood Doors: Staining and finishes for wood doors.

D. Section 099113 - Exterior Painting:

E. Section 099123 - Interior Painting:

F. Section 101423 - Panel Signage: Staining and finishes for wood signage.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and catalog number, and general product category.
   2. Manufacturer's installation instructions.

C. Samples: Two samples on actual wood substrate to be finished, 6 by 6 inch (____ by ____ mm) in size, indicating selected colors and sheens for each system. Include wood fire treatment on sample(s) and note as such.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Extra Stock Materials: Stain and transparent finish materials, 1 gal (4 L) of each color and type; store where directed.
      a. Label each container with color and type in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least five years of documented experience.

B. Applicator Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.07 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 stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature 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.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F (10 degrees C) unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide finishes used in any individual system from the same manufacturer; no exceptions.

B. Transparent Finishes: for
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
   1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each finish material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
   5. The stain color is to match the prefinished stain color of the Suspended Wood Ceilings; it is expected to be a custom mixed stain color and may be a different custom mix color for doors vs. interior wood signs vs. wood ceilings/soffits depending on how the stain absorbs.

2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Interior and Exterior Finish on Wood - interior wood doors, interior wood signage, and interior and exterior ceilings/soffits/canopies.:
   1. Semi-Transparent Finish:
      a. For Exterior Locations: Fire retardant treatment specified in Section 06-0573 Wood Treatment
      b. 1st Coat: Sherwin Williams WoodScapes Semi-Transparent Stain, A15T5 (with custom color mix to match).
      c. 2nd Coat: Sherwin Williams WoodScapes Semi-Transparent Stain, A15T5 (with custom color mix to match).
      d. Clear sealer as recommended by Sherwin Williams.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of stains and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

F. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

G. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

G. Reinstall items removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

END OF SECTION

SECTION 099600
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings (Blackening Steel Stain).

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 055500 Metal Fabrications: Application of blackened steel stain for interior and exterior metal as noted on the drawings.

B. Section 099113 - Exterior Painting.

C. Section 099123 - Interior Painting:

D. Section 101423 - Panel Signage: Application of blackened steel stain for signage.

1.03 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 E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

D. SSPC-SP 5/NACE No.1 - White Metal Blast Cleaning; 2006.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:

1. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
2. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.

C. Samples: Submit seven samples 12 by12 inch (203 by 203 mm) in size on steel illustrating all different color options available for selection. And include another seven separate samples 12 by 12 inch on steel illustrating different "modeling" options of the different colors.

D. Maintenance Data: Include cleaning procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 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 coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature 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.

1.07 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Restrict traffic from area where coating is being applied or is curing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Blackened Steel Stain:
   1. Sur Fin Chemical Company: Surclean-400 Metal Conditioner.
   2. Kingscoat Chemicals: Metal Finishes Plus.

2.02 SYSTEM DESCRIPTION

A. System for Interior and Exterior Blackened Steel Stain Finish:
   1. Step 1: sandblast the steel to remove any mill scale or rust.
   2. Setp 2: Use a metal conditioner to etch the surface fo teh metal for proper take of the blackening stain.
      a. Basis of Design Product: Sur Fin Chemical Company, Surclean-400 Metal Conditioner.
   3. Step 3: Apply blackening stain.
      a. Basis of Design Product: Sur Fin Chemical Company, All products listed in "steel & iron" finish category.
   4. Step 4: Apply top coat of an acrylic sealer or use an automotive clearcoat.
      a. Basis of Design Product: Kingscote Chemicals, Acrylic Sealer (matte or gloss finish to be selected)

2.03 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. 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.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Proceed with coating application only after unacceptable conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Ferrous Metal:
   1. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 5/NACE No.1, and protect from corrosion until coated.

3.03 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written 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.

3.04 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.

3.05 PROTECTION

A. Protect finished work from damage.

3.06 SCHEDULE

A. Color: As selected from manaufacturers full range of colors.

END OF SECTION

DIVISION

10

SPECIALTIES

SECTION 101100
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Magnetic Receptive Dry Erase Wallcovering.

B. Tray and Trim.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Blocking and supports.

B. Section 092116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on marker wallcovering, trim and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.

D. Samples: verification sample of color: white, 2 by 2 inches in size.

E. Manufacturer's printed installation instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.01 WALLCOVERINGS

A. Manufacturers:
   1. Walltalkers Wallcoverings manufactured by Koroseal Interior Products.

B. Materials:
   1. Walltalkers Mag-Rite: Woven backed, ferrous sheet bonded with white pigmented vinyl and capped with semi-gloss, dry erase film.
      a. M248: 47/48 inch width, woven backing.
   2. Trim and Tray:
      a. Quantum Tray: Aluminum blade style marker and eraser tray with angled, smooth-finished ends and installation hardware kit.
         1) QA48TY-00: Silver anodized aluminum, 48 inch length.

2.02 ACCESSORIES

A. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.

B. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.

C. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.

D. Aluminum Marker Caddy: Provide 3 inch high x 7 1/4 inch wide aluminum caddy with four holes and a slot for storing markers and an eraser
   1. AMCM-00: Aluminum marker & eraser caddy w/magnetic backing, silver anodized aluminum.

PART 3 EXECUTION

3.01 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. Test substrate with suitable moisture meter and verify that moisture content does not exceed four percent.

D. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that woudl show through the finished surface.

E. Evaluate all painted surfaces for the possibility of pigment bleed-through.

3.02 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Primer: Use a quality pigmented acrylic wallcovering primer.

D. Adhesive: Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.

E. Install each strip horizontally and in the same sequence as cut from the roll.

F. Install dry erase wallcovering sheets in exact order as they are cut from bolt. Reverse hang laternate strips (except lined product). Do not crease or bend the wallcoving when handling.

G. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.

3.04 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.

END OF SECTION

SECTION 101416
PLAQUES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plaques.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of plaque sign, indicating style, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings: Indicate dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plaques:
   1. Gemini, Inc.

2.02 PLAQUES

A. Metal Plaques:
   1. Material: Aluminum casting.
   2. Material Thickness: Manufacturer's standard.
   3. Sizes: As indicated on drawings.
   4. Border Style: As indicated on drawings.
   5. Background Texture: Leatherette.
   6. Surface Finish: As selected by Architect from manufacturer's full range.
   7. Painted Background Color: Black.
   8. Protective Coating: Manufacturer's standard clear coating.
   9. Mounting: Blind studs.

2.03 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

B. Exposed Screws: Solid brass.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

END OF SECTION

SECTION 101423
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.

D. Samples: Submit one sample, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Verification Samples: Submit samples showing colors, materials, and finishes specified.

F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

G. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Store under cover and elevated above grade.

C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panel Signage:
   1. Custom Fabricated.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

A. Panel Signage:
   1. Application: Interior directional and information and evacuation signs.

2. Description: Flat signs with applied character panel and etched metal media, tactile characters.
3. Sign Size: As indicated on drawings.
4. Color and Font, unless otherwise indicated:
   a. Character Font: League Gothic.
   b. Character Case: Upper case only.
5. Sign Background Materials: metal.
6. Letter Material: Acrylic plastic letters and clear tape braille.
7. Braille: Grade II, ADA-compliant.
8. One-Sided Wall Mounting: Tape adhesive.

2.04 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION

SECTION 102113.19
PLASTIC TOILET COMPARTMENTS - ASI

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments.

B. Solid plastic urinal screens.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Blocking and supports.

B. Section 102800 - Toilet, Bath, and Laundry Accessories.

1.03 ABBREVIATIONS AND ACRONYMS

A. HDPE: High-density polyethylene.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work with placement of support framing and anchors in walls and ceilings.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, accessories, and finishes.

C. Shop Drawings:
   1. Indicate plans, elevations, and dimensions. Include door swings, toilet fixture centerlines, and floor drains on plans.
   2. Indicate details of wall, floor, and ceiling supports and attachments.
   3. Indicate reflected ceiling plan view of partition layout at overhead support locations.

D. Samples:
   1. For Verification: Submit two samples of partition materials, 3 inches by 3 inches (76 mm by 76 mm) in size, indicating color.

E. Manufacturer's qualification statement.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials and products in accordance with manufacturer's instructions and recommendations and industry standards.

B. Do not deliver materials or begin installation until building is enclosed, with complete protection from outside weather, and building temperature maintained at minimum of 60 degrees F (15.6 C).

C. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

D. Lay cartons flat, with adequate support to ensure flatness and prevent damage to prefinished surfaces.

E. Do not store where ambient temperature exceeds 120 degrees F (49 C).

1.09 FIELD CONDITIONS

A. Ambient Conditions: Maintain environmental conditions such as temperature, humidity, and ventilation within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Existing Conditions: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 25-year manufacturer warranty for HDPE material against breakage, corrosion, and delamination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: ASI Global Partitions.

B. Substitutions: See Section 016000 - Product Requirements.

C. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.02 PLASTIC TOILET COMPARTMENTS

A. Toilet Compartments: Solid plastic (HDPE), standard privacy, floor anchored, overhead braced.

B. Urinal Screens: Solid plastic (HDPE), wall hung.

C. Design Criteria:
   1. Accessibility: Design compartments indicated on drawings to comply with ICC A117.1 and ADA Standards.
   2. Fire Performance: Provide assemblies that pass when tested in accordance with NFPA 286.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less (Class B), when tested in accordance with ASTM E84.

D. Fabrication:
   1. Fabricate toilet compartment components to sizes indicated.
   2. Coordinate requirements and provide cutouts for through-partition toilet accessories.
   3. Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
      a. Provide Easy-Stall shoes at floor anchored, overhead braced toilet compartments.
   4. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.

5. Floor-Anchored, Overhead-Braced Units: Provide supports, leveling mechanisms, Easy-Stall shoes, and anchors at pilasters to suit floor conditions.

2.03 COMPONENTS

A. Doors and Panels: Single sheets of solid molded homogenous high-density polyethylene (HDPE).
   1. Finish:
      a. Color: as indicated on the drawings.
      b. Texture: Manufacturer's standard for selected color.
   2. Edges: 1/4-inch (6 mm) radius machined edges.
   3. Heat Sink: Extruded aluminum attached to bottom of doors and panels.

B. Door and Panel Dimensions:
   1. Thickness: 1 inch (25 mm).
   2. Door Width: 24 inches (610 mm).
   3. Door Width for Handicapped Use: 36 inches (915 mm), outswinging.
   4. Door Panel Height: 55 inches (1397 mm).
   5. Door Height Above Floor: 14 inches (355 mm).
   6. Panel Depth: As indicated on drawings.
   7. Urinal/Entrance Screen Panel Height: 55 inches (1397 mm).
   8. Urinal/Screen Screen Panel Height Above Floor: 14 inches (355 mm).

C. Pilasters: 1 inch (25 mm) thick, of sizes required to suit compartment width and spacing; minimum 3 inches (76 mm) wide.
   1. Pilaster Height: 82 inches (2032 mm).
   2. Pilaster Shoes: Formed 20 gauge, 0.0359 inch (0.91 mm) ASTM A666 Type 304 stainless steel with No.4 finish, 5 inches (127 mm) high, concealing floor fastenings; secured to pilaster with stainless steel tamper-resistant screws; secured to floor with concrete anchors.
   3. Easy-Stall Pilaster Shoes: Formed 20 gauge, 0.0359 inch (0.91 mm) ASTM A666 Type 304 stainless steel with No.4 finish, 3 inches (76 mm) high, concealing floor fastenings and leveling bolts; secured to pilaster with stainless steel tamper-resistant screws; secured to floor with concrete anchors.
      a. Provide height and leveling adjustment with machine thread leveling bolts and bottom of pilaster threaded inserts.
   4. Pilaster Anchors: Manufacturer's standard stainless steel mounting bars attached to pilaster and secured to building structure.

D. Head Rails: Hollow anodized aluminum tube, 1- by 1-5/8-inch (25 by 41 mm) size, with anti-grip surface and cast-socket wall brackets.

2.04 MATERIALS

A. High-Density Polyethylene (HDPE):
   1. Composition: Formed from waterproof, nonabsorbent, high-density polyethylene resins.
   2. Properties: Mark-resistant self-lubricating surface.
   3. Fire Resistance: ASTM E84, Class A.
   4. Material Fire Ratings: NFPA 286, Pass.
   5. Material Fire Ratings: ICC (IBC), Class A.

2.05 HARDWARE AND ACCESSORIES

A. Brackets:
   1. Stirrup Type: Clear anodized aluminum, three per panel connection.

B. Door Hardware: Clear anodized aluminum:
   1. Hinges: 8 inch (203 mm) wrap-around pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Latch and Keeper: 6 inch (152 mm) slide latch with wrap-around keeper.

3. Coat Hook: Chrome-plated zamac. Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.
4. Door Pull: Chrome-plated zamac. Provide door pull for outswinging doors. Provide on both sides of doors designated as accessible.
5. Door Bumper: Chrome-plated zamac. Provide rubber-tipped door bumpers at out-swinging doors.

C. Attachments, Screws, and Bolts: Stainless steel , tamper-resistant type..
1. For Attaching Panels and Pilasters to Brackets: Sex-type through-bolts and nuts , tamper-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Attach Easy Stall shoe system to floor with 1/4 by 2 inch (6 by 52 mm) screws. Insert pilaster into Easy Stall shoe and secure after height adjustment.

C. Maintain maximum 1/2-inch (13 mm) space between pilasters and panels.

D. Maintain maximum 1-inch (25 mm) space between wall and panels.

E. Attach panel brackets securely to walls using anchor devices.

F. Attach panels and pilasters to brackets. Locate head rail joints at pilaster centerlines.

G. Do not permit field touch-up of scratches or damaged finish. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

A. Adjust hinges to locate doors in partially opened position when unlatched. Return outswinging doors to closed condition.

B. Adjust adjacent components for consistency of line or plane.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Diaper changing stations.

D. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: blocking and packing for accessories.

B. Section 088300 - Mirrors: Other mirrors.

C. Section 093000 - Tiling: Ceramic washroom accessories.

D. Section 102113.19 - Plastic Toilet Compartments.

E. Division 220000 - Plumbing: Plumbing fixtures.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).

E. ASTM C1036 - Standard Specification for Flat Glass; 2021.

F. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and concealed ceiling supports to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Substitutions: Section 016000 - Product Requirements.

B. Diaper Changing Stations:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.

2. Substitutions: 016000 - Product Requirements.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel.

B. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, and tumbler lock.
   1. Capacity: 300 C-fold minimum.

C. Combination Towel Dispenser/Waste Receptacle: Recessed semi-recessed, stainless steel; seamless wall flanges, continuous piano hinges, ____.

D. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve.

E. Grab Bars: Stainless steel, peened surface.
   1. Heavy Duty Grab Bars: Floor supports are not acceptable.
      a. Push/Pull Point Load: Minimum 1000 pound-force (4448.2 N), minimum.
      b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.125 inch (3.17 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.

F. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Material: Polyethylene.
   2. Mounting: Surface.
   3. Minimum Rated Load: 250 pounds (113.4 kg).

2.07 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 103100
MANUFACTURED FIREPLACES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Indoor decorative wood fireplaces.

B. Indoor gas fireplace log sets.

C. Insulated chimney flue and associated roof flashings.

1.02 RELATED REQUIREMENTS

A. Mechanical Division: Gas piping to firebox logset and venting.

B. Electrical Division: Wiring connections to unit.

1.03 DEFINITIONS

A. Decorative Gas Appliance: Gas appliance designed or installed for visual effect only, cannot burn solid wood, and simulates fire in fireplace.

1.04 REFERENCE STANDARDS

A. ANSI Z21.50 - Vented Decorative Gas Appliances; 2019.

B. ANSI Z21.88/CSA 2.33 - Vented Gas Fireplace Heaters; 2019.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 127 - Standard for Factory-Built Fireplaces; Current Edition, Including All Revisions.

E. UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.

F. UL 907 - Standard for Fireplace Accessories; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide firebox cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvals, and electrical characteristics of fan.

C. Shop Drawings: Indicate layout, elevations, sections, firebox rough opening dimensions, rough opening sizes for chimney flue, required clearances, utility service requirements, attachments to other work, and fan size.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.

PART 2 PRODUCTS

2.01 INDOOR DECORATIVE WOOD FIREPLACES

A. Manufacturers:
   1. Hargrove Premium Products.

B. Description: Manufactured decorative wood fireplaces consist of listed factory-built components, including site built firebox with concealed flue, rectangular-shaped hearth, chimney sections, roof assembly, and other associated parts assembled in accordance with terms of listing. Decorative wood fireplaces are not intended for heating and are exempt from EPA emission standards.

2.02 COMPONENTS

A. Firebox: Formed site constructed refractory brick cabinet with rectangular-shaped interior, configured to include damper, refractory brick lining and vent piping.

B. Flue Construction: Insulated double-wall steel sandwich construction, modular-sized sections with elbows and spacing collars to permit site assembly, air and fire-stop collars, elbows, elbow offsets, tees, supports, roofing storm collar, roof flashing.

1. Products:

a. DuraVent: www.duravent.com/#sle.

2.03 ACCESSORIES

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify prepared openings are ready to receive work and opening dimensions are as indicated on drawings.

3.02 INSTALLATION

A. Comply with applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.

B. Comply with applicable codes for installation of natural gas burning appliances and equipment.

C. Perform electrical work in accordance with NFPA 70.

D. Install unit assembly in accordance with manufacturer's instructions.

END OF SECTION

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 092116 Gypsum Board Assemblies: Roughed-in wall openings.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

B. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.05 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Larsen's Manufacturing Co.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Finish: as indicated on the drawings.

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Configuration: Semi-recessed type.

B. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

C. Fabrication: Weld, fill, and grind components smooth.

D. Finish of Cabinet Interior: as indicated on the drawings.

2.04 ACCESSORIES

A. Cabinet Signage: as indicated on the drawings, affixed to the fire extinguisher cabinet.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, ____ inches (____ mm) from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

END OF SECTION

SECTION 105123
PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic-laminate-clad lockers.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking and nailers.

B. Section 064100 - Architectural Wood Casework: similarly constructed interior casework.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements 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. Samples: Two 3 by 6 inches (75 by 150 mm) in size, of each color scheduled.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic-Laminate-Clad Lockers:
   1. Factory built custom units.

2.02 PLASTIC-LAMINATE-CLAD LOCKERS

A. Lockers: Factory assembled, made of plastic-laminate-faced panels: fully finished inside and out; each locker capable of standing alone.

B. Component Thicknesses:
   1. Doors: 3/4 inch (19 mm) minimum thickness.

C. Hinges: Full height of locker, manufacturer's standard heavy duty type.

D. Coat Hooks: Stainless steel; attached with tamperproof screws.

E. Number Plates: Provide rectangular shaped aluminum plates. Form numbers ____ inch (____ mm) high of block font style with ADA designation, in contrasting color.

F. Built-In hasp for padlock Locks:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Install end panels, filler panels, and sloped tops.

E. Install fittings if not factory installed.

F. Replace components that do not operate smoothly.

3.03 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 105617
WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel shelf standards, brackets, and accessories.

B. Steel shelf support brackets.

C. Shelves.

D. Accessory hooks.

E. See drawings for locations and configurations.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking in walls for attachment of standards.

B. Section 064100 - Architectural Wood Casework: Plastic laminate shelves.

C. Section 092116 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements 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.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 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

2.01 MANUFACTURERS

A. Steel Shelf Standards and Brackets:
   1. Knape & Vogt Manufacturing Company; 87™/187™ Series: www.knapeandvogt.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 COMPONENTS

A. Steel Shelf Standards, Brackets, and Accessories:
   1. Heavy-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
      a. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds (135 to 200 kg) per pair of standards.
      b. Lengths: As indicated on drawings.
      c. Finish: Powder-coated.
      d. Color: To be selected by Architect from manufacturer's full line.

e. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
f. Bracket Quantity: Provide one bracket for each 12 inches (305 mm) of standard length.

B. Shelving:
1. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
a. Edge Finish: Matching laminate, all four edges.
b. Substrate Thickness: 3/4 inch (19 mm), nominal.
c. Length: As indicated on drawings.
d. Laminate: NEMA LD 3 Type HGL.
e. Laminate Color and Pattern: As indicated on drawings.

C. 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

3.01 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.

3.02 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.

3.03 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.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION

12

FURNISHINGS

SECTION 122400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

B. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

E. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Fabric: One year.
   3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Budget Blinds, Inc.; Signature Series.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Basis of Design: as indicated on the drawings.
   2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Window jamb mounted - inside, between jambs.
      d. Size: verify all sizes; to cover all portions of window(s).
      e. Fabric: on the drawings
   3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
   4. Roller Tubes: As required for type of shade operation.
      a. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      b. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
      c. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
   5. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
   6. Manual Operation for Interior Shades:
      a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
      b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb (43 kg) minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
      c. Chain Retainer:
         1) Manufacturer's standard clip.

2.03 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Material: Vinyl coated polyester.
   2. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
   3. Color: as indicated on the drawings.
   4. Fabrication:
      a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
   3. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch (19.05 mm) total.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 123600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work, teller counters and fireplace hearth.

B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework: Countertops installed on cabinet bases.

B. Section 092116 - Gypsum Board Assemblies: Countertops installed on framed walls.

C. Section 093000 - Tiling: Tile for countertops.

D. Mechancial Division: coordination of plumbing fixtures in countertops.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

D. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

F. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

1.04 SUBMITTALS

A. See Section 013000 - 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. 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. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.05 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.

1.06 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.

1.07 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.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
      a. Manufacturers:
         1) Wilsonart: www.wilsonart.com/#sle.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Finish: as indicated on the drawings.
   2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
   3. Back and End Splashes: Same material, same construction.
   4. Fabricate in accordance with manufacturer's standard requirements.

B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
   2. 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. Manufacturers:
         1) Dupont; Corian: www.corian.com/#sle.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Finish on Exposed Surfaces: as indicated on the drawings.
   3. Other Components Thickness: 1/2 inch (12 mm), minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
   5. Skirts: As indicated on drawings.

C. Natural Stone Countertops: Stone slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
   1. Manufacturers:
      a. Arizona Tile.
   2. Stone: Granite without cracks, voids, or pin holes .
   3. Color: as indicated on the drawings.
   4. Stone Thickness: 1/2 inch (12 mm), minimum.
   5. Surface Finish: Polished.
   6. Fabricate in accordance with manufacturer's standard requirements.
   7. Contractor to provide quanitity of slabs needed; architect to reserve slabs at Arizona Tile warehouse in Denver.

D. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
   1. Flat Sheet Thickness: 3/4 inch (19 mm), (nominal) minimum.
   2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Corian quartz.
      b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).

c. Finish on Exposed Surfaces: as indicated on the drawings.
d. Color and Pattern: As indicated on drawings.

3. Other Components Thickness: 3/4 inch (19 mm), minimum.
4. Skirts: As indicated on drawings.
5. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:
1. Material: Steel.
2. Products:
a. As indicated on the drawings.

2.04 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.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
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, Quartz, and Granite: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 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.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).

C. Seal joint between back/end splashes and vertical surfaces.

3.04 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.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 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

DIVISION

14

CONVEYING SYSTEMS

SECTION 142100
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric traction elevator systems.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: elevator pit and wall construction coordination.

B. Section 05120 - Structural Steel: coordination of hoistway beam.

C. Section 055213 - Pipe Tube Railings: coorindation of pit ladder.

D. Section 078400 - Firestopping: coordination of penetrations in fire barrier wall of elevator shaft.

E. Section 096813 - Tile Carpeting: installation of carpet tile in the elevator cab.

F. Electrical Divisions: Coordination of Conduit and Wiring Connections.

G. Fire Protection Divisions: Coordination of fire protection for elevator shaft.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

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. 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. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, Dumbwaiters, and Material Lifts; 2023.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

I. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

L. PS 1 - Structural Plywood; 2023.

M. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to the following:
      a. Elevator equipment devices remote from elevator machine room or hoistway.
      b. Remote group automatic panel from controller cabinet.
      c. Telephone service for elevator cab.
      d. Elevator pit for lighting.

2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to the following:
    a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
    b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation; include provisions for shunt trip power monitoring.

B. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit data on following items:
1. Signal and operating fixtures, operating panels, and indicators.
2. Car design, dimensions, layout, and components.
3. Car and hoistway door and frame details.
4. Electrical characteristics and connection requirements.

C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
4. Individual weight of principal components; load reaction at points of support.
5. Loads on hoisting beams.
6. Clearances and over-travel of car and counterweight.
7. Locations in hoistway of traveling cables and connections for car lighting and telephone.
8. Location and sizes of hoistway and car doors and frames.
9. Electrical characteristics and connection requirements.
10. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

D. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of cut sheets or actual samples.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

G. Operation and Maintenance Data:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Operation and maintenance manual.
3. Schematic drawings of equipment and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer Qualifications: Supervisor along with trained elevator installation personnel on staff of elevator equipment manufacturer.

C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electric Traction Elevators:
   1. KONE; KONE MonoSpace 300 DX: www.kone.us/#sle.
   2. Otis Elevator Company; Gen3 Core: www.otis.com/#sle.
   3. TK Elevator; Evolution 200: www.tkelevator.com/#sle.

B. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.02 ELECTRIC TRACTION ELEVATORS

A. Electric Traction Passenger Elevator:
   1. Electric Traction Elevator Equipment:
   2. Drive System:
      a. Solid-state electronic device with alternating current (AC) with regenerative drive.
   3. Operation Control Type:
      a. Destination-Based Group Automatic Operation Control.
   4. Service Control Types:
      a. Standard service control.
   5. Interior Car Height: manuafacturer's standard for the model.
   6. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
   7. Rated Net Capacity: 2100 pounds (950 kgs).
   8. Rated Speed: 80 feet per minute (___ m per second).
   9. Hoistway Size: As indicated on drawings.
   10. Interior Car Platform Size: manufacturer's standard for model.
   11. Elevator Pit Depth: 60 inch (1524 mm).
   12. Travel Distance: As indicated on drawings.
   13. Number of Stops: As indicated on drawings.
   14. Number of Openings: as indicated on the drawings Front.
   15. Traction Machine Location: manufacturer's standard location.

2.03 COMPONENTS

A. Elevator Equipment:
   1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70 requirements; see Section 260583 for additional information.
   2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets, and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
   3. Lubrication Equipment:
      a. Provide grease fittings for periodic lubrication of bearings.
      b. Grease Cups: Automatic feed type.
      c. Lubrication Points: Visible and easily accessible.

2.04 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

B. Accessibility Requirements: Comply with ADA Standards.

C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.

D. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
   1. Comply with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7, and other related requirements.
   2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
   3. Provide seismic switch in accordance with ASME A17.1 and ASCE 7 requirements.

E. Perform welding of steel in accordance with AWS D1.1/D1.1M.

F. Fabricate and install door and frame assemblies in accordance with NFPA 80 and complying with requirements of authorities having jurisdiction (AHJ).

G. Perform electrical work in accordance with NFPA 70.

H. Comply with fire protection sprinkler system of hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction (AHJ). See Section 211300.

2.05 OPERATION CONTROLS

A. Elevator Controls: Provide landing operating panels and landing indicator panels.
   1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
   2. Landing Indicator Panels: Illuminating.
   3. Comply with ADA Standards for elevator controls.

B. Interconnect elevator control system with building fire alarm and smoke alarm systems.

C. Door Operation Controls:
   1. Program door control to open doors automatically when car arrives at floor landing.
   2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
   3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.

D. Lobby Monitoring Panel:
   1. Locate status indicator and control panel for each individual elevator and group of elevators as indicated on drawings.
   2. Etch face plate markings in panel, and fill with paint of contrasting color.
   3. Include direction indicator displaying landing "Up" and "Down" calls registered at each landing floor.
   4. Include position and motion display for direction of travel of each elevator; display appropriate graphic characters on non-glare screen; indicate position of cars at rest and in motion.

2.06 OPERATION CONTROL TYPE

A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.
   1. Refer to description provided in ASME A17.1.
   2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
   3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons actuated, but the stops are made in the order that landings are reached in each direction of travel.
   4. All "UP" landing calls are made when car is traveling in the up direction.
   5. All "DOWN" landing calls are made when car is traveling in the down direction.

6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.

2.07 SERVICE CONTROL TYPE

A. Independent Service Control:
   1. Provide key-operated "Independent Service" on car operating panel. Key activation will remove that car from normal operation and cancel preregistered car calls.
   2. Car will respond to selected floor. Car will not respond to any calls from landing call buttons. Car will only respond to calls placed on the car operating panel. Doors will remain open at last landing requested. Doors will close with a constant pressure on "Door Close" button.
   3. Key activation to normal operation will return car to normal operation.

B. Restricted Access Service Control:
   1. Program down traveling cars to stop at main floor landing prior to proceeding to a designated lower dispatch landing.
   2. Landing Call Lock-Out: Provide a key-operated switch with key removable from "On" or "Off" position in landing control station that performs the following when activated:
      a. Restricts or permits landing call registration for that landing.
      b. Causes the elevator to not respond to that landing.

2.08 MATERIALS

A. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

B. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.

C. Plywood: PS 1, Structural I, Grade C-D or better, sanded.

D. Tile Carpet Flooring: See Section 096813.

E. Plastic Laminate: NEMA LD 3, Type VGS, color as selected by Architect from manufacturer's standard line of colors.

2.09 CAR AND HOISTWAY ENTRANCES

A. Elevator, _____:
   1. Car and Hoistway Entrances:
      a. Hoistway Fire Rating: 1 Hour.
      b. Framed Opening Finish and Material: Baked enamel on steel.
      c. Car Door Material: Baked enamel on steel, with rigid sandwich panel construction.
      d. Hoistway Door Material: Baked enamel on steel, with rigid sandwich panel construction.
      e. Door Type: Double leaf.
      f. Door Operation: Side opening, two speed.
      g. Paint Color: As selected by Architect from manufacturer's standard line.
      h. Door Width: 36 inch (0.914 m).
      i. Door Height: 84 inch (2.134 m).
      j. Sills: Extruded aluminum.

2.10 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:
   1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
      a. Panel Material: Integral with front return; one per car.
      b. Car Floor Position Indicator: Above door with illuminating position indicators.
      c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch (1372 mm) above car finished floor.
      d. Provide following within service cabinet as part of car operating panel:

1) Emergency light.
2) Telephone cabinet and hard-wired connection with telephone.

2. Flooring: Carpeting.
3. Wall Base: Recessed baked enamel on steel, 4 inch (102 mm) high.
4. Front Return Panel: Match material of car door.
5. Door Wall: Baked enamel on steel.
6. Side Walls: Plastic laminate on plywood.
7. Rear Wall: Plastic laminate on plywood.
8. Hand Rail: Stainless steel, at three side walls. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
   a. Stainless Steel Finish: No. 4 Brushed.
9. Ceiling:
   a. Canopy Ceiling: Plastic laminate on plywood.
   b. Lighting: As selected from manufacturer's standard line.
10. Provide emergency access panel for egress from car at ceiling.

B. Car Accessories:

2.11 MACHINE ROOM FITTINGS

A. Key Cabinet: Wall-mounted, lockable, keyed to building keying system, for control and operating panel keys.

2.12 FINISHES

A. Baked Enamel on Steel: Clean and degrease metal surface; apply one coat of primer sprayed and baked; two coats of enamel sprayed and baked.

B. Finish Paint for Metal Surfaces: Alkyd enamel, semi-gloss, color as selected, comply with VOC limitations of authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that hoistway, pit, and machine room are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

3.02 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components, and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories; see Sections 260533.13 and 260583.

D. Mount machines and motors on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.

E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

F. Install guide rails to allow for expansion and contraction movement of guide rails.

G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

H. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

I. Structural Metal Surfaces: Clean surfaces of rust, oil, or grease; wipe clean with solvent; prime with two coats.

J. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

K. Adjust equipment for smooth and quiet operation.

3.03 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.

B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.04 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch (6.4 mm) maximum from flush with sill.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective coverings from finished surfaces.

C. Clean surfaces and components in accordance with manufacturers written instructions.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals for closeout submittals.

B. See Section 017900 - Demonstration and Training for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Training: Train Owner's personnel on cleaning and 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.

3.07 PROTECTION

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch up, repair, or replace damaged products and materials before Date of Substantial Completion.

3.08 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements for additional requirements relating to initial maintenance service.

B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for three months from Date of Substantial Completion.

C. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or installer.

D. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.

E. Include systematic examination, adjustment, and lubrication of elevator equipment.

F. Maintain and repair or replace parts whenever required using parts produced by original equipment manufacturer.

G. Replace wire ropes when necessary to maintain the required factor of safety.

H. Perform work without removing cars from use during peak traffic periods.

I. Provide emergency call back service during regular working hours throughout period of this maintenance contract.

J. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

DIVISION

20

GENERAL MECHANICAL REQUIREMENTS

SECTION 20 0500 - GENERAL PLUMBING AND HVAC

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work to be performed under the Plumbing, HVAC, and/or BAS sections of the specification shall include all supervision, labor, equipment, and materials required and incidental to providing and installing complete and adjusted systems, as shown on the drawings and described herein.

B. All specification requirements shall be considered complementary to other specification sections for the project. Where conditions of this section conflict with bidding instructions and/or other general conditions, the contractor shall request clarification throughu the engineer prior to bidding the work.

C. The contractor shall plan the work in advance and coordinate all installation requirements with other trades. Contractors shall be held to have checked all construction documents for possible interference caused by work of other trades, conditions of the premises, and obstructions. Where conflicts occur, the contractor shall request clarification through the general contractor.

D. Note that the term "general contractor" as used through-out these specifications may apply to a prime contractor, or a construction manager, or another term as appropriate for the particular delivery method. Where the primary contract holder is not performing the function of a general contractor, the term will apply to this contractor.

E. Execution of the work shall be governed by the construction documents: architectural, structural, plumbing, hvac, and electrical drawings, where applicable, as well as drawings of associated trades. Locations of piping, equipment, ducts, etc on the drawings are diagrammatic; indicated positions shall be followed as closely as possible, however exact locations shall be subject to building construction conditions and interferences with other work.

1.2 CODES RULES PERMITS AND FEES

A. Materials furnished and work installed shall comply with all state and locally adopted nationally recognized and consolidated building codes and standards, with requirements of local utility companies, and with the requirements of all governmental authorities having jurisdiction.

B. The contractor shall give all necessary notices, obtain all permits and pay all sales taxes, fees, and other costs, including utility connections or extensions, in connection with his work; file all necessary plans, prepare documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection and deliver same to the engineer before request for acceptance and final payment.

C. The contractor shall include in the work, without extra cost to the owner, any labor, materials, services, apparatus, etc to comply with all applicable laws, ordinances, rules and regulations, whether indicated or not on the drawings. Where materials or installations that are specified or detailed in a way that conflicts with or is perceived to conflict with governing regulations, the contractor shall request clarification from the engineer prior to bidding.

1.3 CONSTRUCTION DRAWINGS

A. The drawings and the specifications are intended to be complimentary. Where conflicts exist on the drawings or between the drawings and the specifications, and the contractor fails to notify the engineer prior to issuance of the final addendum, the contractor will be held to have considered and included the most expensive option in the bid. No changes or extras will be given for one option over the other.

B. Drawings indicate suggested routing of pipes, ducts, and other conduits. It is not intended that drawings indicate all offsets that may be necessary to avoid conflicts with structure, work of other trades, or other conflicts. The contractor shall plan installation to conform to the structure, avoid obstructions, and preserve clearance, without additional cost to the project.

C. Drawings are diagrammatic and generally indicative of the work. The contractor shall follow the drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Confirm conditions in the field and coordinate with other trades prior to rough-in. All equipment shall be installed such that access is maintained for serviceability.

D. Before fabrication, piping and ductwork shall be checked with the building construction for dimensions, locations, clearances, etc. Ductwork and piping shall be made up with the necessary variations to conform to the details of the construction of the building. Ductwork and piping that is made up before hand and found that it will not fit into allocated spaces shall be re-constructed at no additional expense to the project.

E. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the engineer shall be notified before proceeding with installation to prevent conflict with work of other trades and for proper execution of the work.

1.4 SURVEYS AND MEASUREMENTS

A. The contractor shall base all measurements, both horizontal and vertical from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements on site and check the correctness of same as related to the work.

B. Should any discrepancy be discovered between actual measurements and those indicated, which prevents following good practice or the intent of the drawings, the contractor shall request clarification through the general contractor, and shall not proceed with the work until instructions are received from the engineer.

1.5 SUBSTITUTIONS

A. A specification in which a manufacturer's product is named and accompanied by the words "basis of design", including make or model number or other designation, shall establish significant qualities and other characteristics for purposes of evaluating comparable products of additional manufacturers.

B. Where specifications name a basis of design product, or refer to a basis of design product indicated on the drawings, and other products or manufacturers are not listed, provide the specified or indicated product or an approved comparable product. Equipment scheduled on the drawings shall be considered the "basis of design".

C. Wherever the word "equal", or words to the same effect are used in connection with a specified product, it is to be understood that such words mean any product claimed to be an equal shall be reviewed and accepted in writing by the engineer. Products and materials not specifically identified as accepting “equals”, and which have not been submitted for prior review, will be summarily rejected.

D. Pre-bid requests for substitution must be received by the engineer one calendar week prior to the bid date (or as otherwise specified in the instructions to bidders), so that they may be processed and included by addendum for the benefit of all bidders. Requests received after the deadline will not be considered. A substitution request form must accompany each individual application with undersigned certification as described below.

E. Requests shall indicate the paragraphs and/or drawing details from which the proposed construction and/or function varies from the items specified, and shall provide complete data showing and explaining all such changes or variations the bidder proposes to make from the drawings and specifications.

F. It is further understood that no material or work shall be presented to the engineer as equal to that specified without the full understanding on the part of the manufacturer, the supplier, and the contractor, that the engineer is to use his own judgment in determining equivalency, and the decision is final.

1.6 SUBSTITUTION REQUESTS

A. Document each request with complete point-by-point comparative data substantiating compliance of the proposed substitution with the contract documents. Submit shop drawings, product data, etc, attesting to the proposed product equivalence. Burden of proof is on the proposer. Clearly indicate all salient points.

B. A request for substitution constitutes a representation that the submitter certifies the following:

1. Proposed product has been fully investigated and determined to be equal or superior in all respects to specified product.
2. Proposed product is consistent with the design and/or design intent and will not require revisions to the contract documents.
3. Proposed product is compatible with other portions of the work, and will produce the intended results.
4. Proposed product will not affect dimensions and functional clearances, and will have no adverse effects on other trades.
5. Claims for additional costs or time extension that may subsequently become apparent will be waived.
6. Payment will be made to the engineer and/or other trades for changes to building design and/or construction.

C. Equipment may have been originally selected with certain capabilities for safety factor, future considerations, adjustment beyond scheduled values, etc. Substituted equipment submitted as equal shall be capable of achieving the basis of design performance and/or capacities, regardless of how it is scheduled.

D. Acceptance of a proposed manufacturer for bidding does not constitute final approval of the substitution to imply that it meets all specific and significant qualities of the scheduled or specified product. The specified product shall remain the “basis of design” and all substitute product or equipment manufacturers remain subject to requirements therein.

E. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the drawings will be revised to reflect the substitution.

1.7 EQUIPMENT DEVIATIONS

A. Where the contractor has proposed to use an item or equipment other than that specified or detailed on the drawings, which requires any redesign of the structure or any other part of the design, all such redesign, and all new drawings and detailing required thereof, shall be prepared by the contractor at his own expense and submitted for approval by the engineer.

B. Where such accepted deviation requires a different quality, capacity, or arrangement of related equipment, ductwork, piping, wiring, or conduit from that specified or indicated on the drawings, the contractor shall furnish and install all such material and equipment required at no additional cost and with no additional time added to the contract.

1.8 SUBMITTALS FOR REVIEW

A. Prior to delivery of any equipment or material to the jobsite, the contractor shall submit for review, detailed shop drawings and/or product data cut sheets of all equipment and materials required to complete the project. No material or equipment may be delivered to the jobsite or installed until the contractor has in his possession the reviewed submittals for the particular material or equipment.

B. Submittals shall include detailed, dimensioned cut sheets showing manufacturer, model, construction, quantity, size, arrangements, operating clearances, performance characteristics, and capacity. Each item of equipment proposed shall be a standard catalog product or custom modified version of an established manufacturer, and of equal quality, fit, finish, durability, and performance to those specified or scheduled.

C. Unless otherwise approved in advance, all submittals and resubmittals for each division shall be transmitted to the engineer at one time. Submittals shall be transmitted sufficiently in advance to allow ample time for review. Review will not commence until all submittals for a particular division are received. Partial submittals will be returned without review. Failure to submit with ample time for checking shall not entitle an extension of contract time.

D. Samples, drawings, specifications, catalogs, etc submitted for review, shall be properly labeled indicating contractors name and title of project, section/article number of specifications governing, and specific service and size range for which material or equipment is to be used, with model numbers and accessories clearly marked.

E. The purpose of submittals is to demonstrate the way by which the contractor proposes to conform to information given in the contract documents. There is no alleged responsibility of the engineer for failing to catch the contractor’s errors in submittals.

F. The work shall be in accordance with approved submittals, except that the contractor shall not be relieved of responsibility for deviations from requirements of the contract documents by the engineer's approval of shop drawings, product data, or other submittals.

G. Review rendered shall not be considered as a guarantee of building conditions. The contractor is responsible for dimensions, which shall be confirmed at the job site; coordination of his work with that of other trades, quantities required, and the satisfactory performance of his work.

1.9 DIGITAL SUBMITTALS

A. At the contractor's option, paperless electronic submittals may be transmitted in an Adobe PDF formatted file. Electronic submittals and resubmittals are subject to all outlined requirements listed above. Submittals shall be arranged according to individual sections and submitted separately by section. Do not combine into a comprehensive package. Do not split individual sections. File names shall include the specification number and title.

B. When resubmitting submittals, transmit the full and complete submittal section, such that a single reviewed and accepted submittal file will exist on the record and with the general contractor on the jobsite. Partial resubmittals and/or loose cut sheets will be rejected.

C. Remove all rejected pages, pages not applicable to the submittal, and/or pages that are being changed for the resubmittal. Insert all new pages into the digital file in the appropriate locations, labeled and indicated as specified above.

D. Return the digital file with the same or similar identifying file name, including the specification section number and title, and article or paragraph numbers where applicable.

E. Where these instructions are not followed, submittals will be summarily rejected. The contractor is responsible for providing properly formatted submittals with sufficient time for review.

1.10 DELEGATED DESIGN SUBMITTALS

A. Where indicated, the contractor shall provide professional services or certifications by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, shop drawings, and other submittals prepared by such professional.

B. Shop drawings and other submittals related to the work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted for review.

C. The Owner and the engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by such design professionals.

D. The engineer will review, approve, or take other appropriate action on submittals only for the limited purpose of checking for conformance with the information given and the design intent expressed in the contract documents.

E. Work on the project shall not begin until submittals have been accepted by the engineer, and the Authority Having Jurisdiction where applicable.

1.11 COOPERATION WITH OTHER TRADES

A. This contractor shall give full cooperation to other trades and shall furnish in writing to said trades, with copies to the engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Where work of this contractor will be installed in close proximity, or will interfere with work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. In general, sanitary waste and vent and roof drains shall have precedence; ductwork shall have precedence over all other plumbing and piping; piping shall have precedence over conduit, etc.

C. If so directed by the engineer, the contractor shall prepare composite working drawings and sections at a suitable scale not less than a quarter inch, clearly showing how his work is to be installed in relation to the work of other trades. If the contractor installs his work before coordinating with other trades, so as to cause any interference with work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.

D. The contractor shall furnish other trades all approved submittals, necessary templates, patterns, setting plans, and shop details for the purpose of coordinating adjacent work or for the proper installation of common work and equipment.

1.12 MATERIAL AND WORKMANSHIP

A. All material and apparatus required for the work, except as specified otherwise, shall be newly manufactured, of best quality, and shall be furnished, delivered, erected, connected and finished in every detail. Where no specific kind of quality of material is given, a best-in-class standard article as approved by the engineer shall be furnished.

B. The contractor shall furnish the services of an experienced superintendent, who shall be continuously in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, welders, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate, and test each system.

1.13 GUARANTEES AND WARRANTEES

A. The contractor shall guarantee, in writing, that all work installed will be free from any and all defects in workmanship and/or materials; that all apparatus will develop capacities and characteristics specified; and that if, during a period of one year, or as otherwise specified from the date of substantial completion, any such defects in equipment, workmanship, material or performance appear, the contractor will remedy such defects within a reasonable time and without additional cost to the owner.

B. The manufacturer shall guarantee that individual items or groups of items furnished shall have capacities equal to or greater than that specified and shall be suitable for the intended application. All warranties commence on the date of substantial completion, unless noted otherwise. Furnish manufacturer's written warranties on all equipment to the owner stating the effective date of warranty.

C. In default thereof, the Owner may have such work done and charge cost to the contractor.

1.14 MANUFACTURER'S SPECIFICATIONS

A. Manufacturer's installation instructions shall have the same force and effect as though written in full in these specifications. Where conflicts occur between the manufacturer's instructions and the documents, the contractor shall seek clarification from the engineer prior to installation.

B. Where the construction documents require that a material, article, or apparatus shall be applied, installed, assembled, connected, cleaned, started, etc, in accordance with the manufacturer's specifications, directions, or recommendations, said instructions shall have the same force and effect as though written in full in these specifications.

1.15 FIRE RATED ASSEMBLIES

A. The contractor shall be responsible for maintaining the integrity of all fire rated ceiling and wall assemblies. Where penetrations are required into ceilings or sections of ceilings are removed to install support members, the contractor shall be responsible for patching the ceiling with an approved fire rated wallboard. Tape, seal, texture and paint to match all surrounding surfaces. This shall apply to all new penetrations and any existing penetrations through-out the project.

PART 2 EXECUTION

2.1 EXCAVATION AND TRENCHING

A. Mass excavation to approximate building levels will be carried out under a section of the architectural specifications. Except as otherwise noted on drawings, this contractor shall be responsible for trench and pit excavations and backfilling required for work under this section of the specifications, inside and outside the building, including all required shoring, bracing, and/or pumping, and all protection for safety of persons and property. Local or state safety codes shall be strictly observed.

B. It shall be the responsibility of this contractor to check the indicated elevations of utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the engineer shall be notified of such conditions and approval shall be made before excavations are commenced. It is also the responsibility of the contractor to make excavations at the minimum required depths and locations to prevent undercutting the footing.

C. Verify locations of all existing and/or new underground utilities prior to trenching and, if damaged by this contractor, replace immediately in an approved manner and at no expense to the project. Piping and electrical work shall not be installed in the same ditch.

D. When rock is encountered during excavation, it shall be addressed as outlined under the architectural section of these specifications.

2.2 HANDLING AND PROTECTION

A. The contractor shall protect all work and material from damage by his work or workmen, and shall be liable for all damage thus caused. The contractor shall be responsible for work and equipment until finally inspected, tested, and accepted. The contractor shall protect material and equipment received on site which is not immediately installed.

B. All open ends of piping, ducts, and equipment shall be closed with temporary covers or plugs during storage and construction to prevent entry of dirt or obstructing material. Where this has not been done, the contractor shall provide cleaning services at no additional cost to the project.

2.3 ACCESSIBILITY AND PANELS

A. The contractor shall be responsible for the size of shafts and chases, and adequate clearance in partitions and ceiling space for the proper installation of the work. Advise the general contractor of any requirements and cooperate with all other trades whose work is in the same space, and shall advise the general contractor of his requirements. Such spaces and clearances shall be kept to the minimum size required.

B. The contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Accessible equipment shall include but not be limited to, fire and smoke dampers, volume dampers, coils, valves, traps, clean-outs, motors, controllers, and drain points. Provide clearances at all electrical panels in accordance with the NEC.

C. Furnish metal access panels with screwdriver cam-locking device of required size and type to provide access to devices concealed in walls, ceilings, or furred-in spaces. Furnish access panels to the general contractor for installation as directed by this contractor. Location of these panels shall be communicated in sufficient time to be installed in the normal course of work.

D. Panel size shall be minimum 12-inches x 12-inches and larger as conditions may demand. Panel size shall be 22-inches x 22-inches where shoulder access is needed. Panels shall be of the type necessary for the particular construction in which they occur and shall be approved for fire-rated assemblies where required. See architectural specifications for panel types.

2.4 FOUNDATIONS AND SUPPORTS

A. Unless noted on the drawings, this contractor shall be responsible for installation of all necessary foundations, supports, curbs, pads, bases, and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this contract, and shall submit drawings to the engineer for approval before purchase, fabrication, or construction.

B. All equipment, unless shown otherwise, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the engineer, not strong enough shall be replaced as directed.

C. This contractor shall furnish all temporary equipment such as ladders, scaffolding, rigging, hoisting, and services necessary for proper and safe execution of the work, and delivery onto the premises of any equipment and apparatus furnished.

2.5 CUTTING AND PATCHING

A. The general contractor will typically provide for all openings in construction. The mechanical contractor shall coordinate sizes and locations of openings and shall be responsible for all cutting and patching as necessary when sizes or locations are incorrectly communicated. No

structural members shall be cut without the approval of the engineer, and all such cutting shall be done in a manner directed by him. Patching shall match adjacent surfaces.

B. Damages to new and existing masonry or brick veneers as the result of cutting or core drilling for penetrations of ductwork, grilles, louvers, piping, etc shall be repaired by an independent contractor without additional cost to the owner. Said contractor shall be regularly engaged in the masonry business with documented experience of at least five years.

2.6 SLEEVES AND PLATES

A. Sleeves shall be provided for all conduits passing through concrete floor slabs and masonry, tile, gypsum, and concrete wall construction. Locate all sleeves and inserts required before the floors and walls are built, or be responsible for the cost of cutting and patching required for pipes where sleeves and inserts penetrate existing construction, or where they were not installed or incorrectly located.

B. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes the sleeves shall be large enough to pass the and the insulation.

C. Where sleeves are located in fire-rated assemblies, fill space between pipe and sleeve with a listed and approved "fire stop" material. Where sleeves are placed in exterior walls, the space between the pipe and the sleeve shall be sealed with a weather tight caulk.

D. Check floor and wall construction finishes to determine proper length of sleeves for various locations. Terminate sleeves flush with walls, partitions and ceilings. In chase areas where pipes are concealed, terminate sleeves flush with floor. In all mechanical rooms and chases where pipes are exposed, extend sleeves 2-inches above finished floor.

E. Fasten sleeves securely in floors and walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials being forced into the sleeve during construction.

F. Escutcheon plates shall be provided for all exposed uninsulated pipes passing through walls, floors, and ceilings. Plates shall be nickel plated, of the spring ring type, sized to match the pipe. Where plates are provided for pipes passing through sleeves that extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

G. This contractor shall be responsible for providing flashing for all required exterior penetrations. It is this contractor's responsibility to have reviewed design team drawings for roof and wall construction types and to provide the appropriate penetration flashings for installation by the general contractor. All penetrations shall be sealed weather-tight.

2.7 FIRE SAFE SEALANTS

A. Provide and install an elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct and piping penetrations through walls and floors, and having a UL tested and approved fire-resistance rating for the intended construction.

2.8 LUBRICATION OF EQUIPMENT

A. Properly lubricate all pieces of equipment before turning the building over to the owner. A tag shall be attached to each motor showing the date of lubrication and lubricant needed.

2.9 QUIET OPERATION AND VIBRATION

A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the engineer. In the case of moving machinery, sound or vibration noticeable outside the room where the equipment is located, will be considered objectionable.

B. Conditions shall be corrected in an approved manner by the contractor at no additional cost to the project. Vibration control shall be by means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

2.10 MOTORS

A. Motors shall be built in accordance with the latest NEMA standards and as specified. Motors shall be tested in accordance with standards of ASA C50 and conform thereto for insulation resistance and dielectric strength.

B. Each motor shall be provided with a conduit terminal box and adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under all conditions of operations and load without overload, at the horsepower indicated or specified.

C. All motors rated greater than 1000 watts shall have a power factor of not less than 85% at rated load.

2.11 ELECTRICAL CONNECTIONS

A. The electrical contractor will furnish and install all wiring except temperature control wiring, equipment control wiring which does not conduct full load motor current, and interlock wiring.

B. The electrical contractor will furnish and install all power wiring complete from the power source to the motor or equipment junction box, including power wiring through starters.

C. Control relay and control transformers shall be furnished under the mechanical contract except where furnishing such items is specifically required under the electrical contract.

D. The electrical contractor will furnish and install all starters not factory mounted on equipment.

PART 3 CLOSEOUT

3.1 CLEANING AND FINISHING

A. The contractor shall go over the work and clean all equipment, fixtures, duct, piping, etc. Wipe down exterior surfaces; vacuum, wash, and clean interiors of all fan cabinets, air handlers, etc.

B. The contractor shall clean all dirt and debris from mechanical spaces, within and around all equipment (regardless of fault, pre-condition, or who the mess belongs to).

3.2 SYSTEM OPERATION

A. The contractor shall provide allowance in his bid to demonstrate that each system operates according to the specification. The contractor shall arrange to have all subcontractors (temperature control, sheet metal, plumbing, balancing, etc.) available to demonstrate to the engineer that each system performs properly.

B. If the equipment is installed improperly, is found to be faulty, or the contractor's personnel or subcontractors are not available and the demonstration requires more than one visit to the site, this contractor shall be responsible for additional time incurred by the engineer and agrees that the owner may deduct hourly fees from the amount otherwise due the contractor.

3.3 RECORD DRAWINGS

A. The contractor shall maintain a complete set of plumbing and mechanical drawings at the site, with all changes marked neatly thereon in a contrasting color. This set shall not be used for any other purpose. Keep the drawings current at all times.

B. At the completion of the project, the contractor shall record all changes on a clean set of drawings and present this set to the engineer. This set shall be dated and clearly marked "Record Drawings".

3.4 OPERATING INSTRUCTIONS

A. Upon completion of all work and all tests, the contractor and his subcontractors shall furnish the necessary skilled labor and helpers for demonstrating operation of the system and equipment for at least one 8-hour day, or as otherwise specified in individual sections.

B. During this period, instruct the Owner or his representative fully in the operation, adjustment, and maintenance of all equipment furnished. Give at least one week notice to the Owner and the engineer in advance of this period.

3.5 MAINTENANCE MANUAL

A. This contractor shall furnish a minimum of three (3) operation and maintenance manuals. Each manual shall include a title sheet showing the engineering firm, general contractor, plumbing contractor, sheet metal contractor, and temperature control contractor. List phone numbers and addresses for all firms. Each manual shall also consist of the following, but is not limited to:

1. Table of contents.
2. Mechanical written guarantees.
3. List of all mechanical equipment suppliers.
4. Maintenance items and frequency of maintenance.
5. Equipment shop drawings and manufacturer service books.
6. Temperature control schematics.

7. Balancing and start-up reports.
8. Cleaning and treatment certifications.
9. Air and water filter replacement list.
10. Plumbing fixture shop drawings.
11. Parts list on all faucets and flush valves.

B. The contractor shall supply all shop drawings, part lists, and manufacturer's operation and maintenance literature. All type written pages shall be inserted in “plastic sheet protectors” and each section separated with tabbed dividers. Three-ring or D-ring "presentation type" binders shall be used, with the project title and date in protected plastic sleeves under the cover and the end.

C. Paperless operation and maintenance manuals will be accepted with prior approval from the engineer. Manuals shall be submitted in a single, bound, Adobe PDF formatted file, complete with all outlined sections and requirements listed above. Multiple loose files will not be acceptable.

END OF SECTION

SECTION 20 0510 - MOTOR REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single phase electric motors

B. Three phase electric motors.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer's catalog literature for each type of product indicated.

C. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Source Limitations: Obtain field-installed motors through one source from a single manufacturer.

C. 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.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.
5. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
6. Matched to torque and horsepower requirements of the load.
7. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

PART 2 PRODUCTS

2.1 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three Phase (or as scheduled).

B. Motors Smaller Than 3/4 HP: Single Phase (or as scheduled).

C. Frequency Rating: 60Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open drip-proof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105F and at altitude of 3300-ft above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Re-greasable, shielded, anti-friction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 HP and larger; rolled steel for motors smaller than 7.5 HP.

2.3 ADDITIONAL REQUIREMENTS

A. Motor Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Energy and premium efficiency motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Provide optional motor shaft grounding rings on all motors 5 HP and larger.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

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

3.2 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

3.3 QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

END OF SECTION

SECTION 20 0515 - COMMON WORK RESULTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rubber packless expansion joints.

B. Sleeves and sleeve-seal systems.

C. Escutcheons and plates.

D. Access doors and covers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer’s catalog literature for each type of product indicated.

1. Include construction details, material descriptions, and dimensions of individual components, and finishes.

2. Include operating characteristics and furnished accessories.

1.5 COORDINATION

A. Coordinate installation of expansion devices with installation of piping, pumps, and other equipment.

B. Coordinate installation of sleeves with the installation of concrete walls, masonry walls, and concrete floor and roof slabs.

C. Coordinate installation of sleeves with size, location, and installation of service utilities.

D. Coordinate installation of escutcheons and plates with installation of piping and ductwork.

E. Coordinate installation of access doors with size and location of serviceable devices.

PART 2 PRODUCTS

2.1 RUBBER EXPANSION JOINTS

A. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Material: Twin reinforced EPDM-rubber spheres with external restraining cables.

C. Minimum Pressure Rating: 150 psig at 200 deg F.

D. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. Molded-PE or PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to forms.

2.3 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

B. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Carbon steel.

D. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed or exposed rivet hinge, and spring-clip fasteners.

2.5 ACCESS COVERS

A. Furnish and install access covers for all concealed valves, water hammer arrestors, and other serviceable equipment not accessible from utility spaces.

B. All doors to be minimum 16-gauge construction. All doors to be removable from frames. All hinges shall be concealed type; exposed piano hinges are not permitted.

C. All doors and covers located in rated construction shall be supplied with a fire rating equal to or greater than the rated assembly.

D. See architectural divisions for access door specifications that supercede these. Provide access doors to the general contractor for installation in construction.

E. Access door schedule:

1. Masonry surfaces - Prime coated steel with cylinder lock.
2. Painted surfaces - Prime coated steel with cylinder lock.
3. Tiled surfaces - Satin finish stainless steel with cylinder lock.
4. Fire rated walls - Prime coated steel with self-latching bolt and flush key.

PART 3 EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install rubber packless expansion joints at pump connections.

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

E. Install line size flexible pipe connectors on pipes connected to vibration isolated equipment.

3.2 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in concrete and masonry walls, concrete floors, and concrete roof slabs as new walls and slabs are constructed.

1. Extend sleeves installed in floors of mechanical equipment areas, plumbing and piping chases, or other wet areas 2 inches above finished floor level.
2. In all other locations, cut sleeves to length for mounting flush with both surfaces. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
4. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

C. Escutcheon Plates: Install one-piece or split hinge metal plates for pipes passing through floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chrome plated escutcheons in finished spaces and metal plates with paint finish in unfinished areas.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building. Sleeves are not required for core drilled holes.

B. Select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls. Sleeves are not required for core drilled holes.

C. Select type, size, and number of sealing elements required for piping material and size, and for sleeve ID or hole size.

1. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve.

D. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

E. Sleeve and sleeve-seal schedule

1. Exterior Concrete Walls below Grade:
    a. Piping NPS 6 and Smaller: Cast-iron wall sleeves with sleeve-seal system.
    b. Piping Larger than NPS 6: Not applicable.
2. Concrete Slabs-on-Grade:
    a. Piping NPS 6 and Smaller: Cast-iron wall sleeves with sleeve-seal system.
    b. Piping Larger than NPS 6: Not applicable.
3. Concrete and Masonry Walls above Grade:
    a. Piping NPS 6 and Smaller:
        1) Cast-iron wall sleeves.
        2) Galvanized-steel-pipe sleeves.
    b. Piping Larger than NPS 6: Not applicable.
4. Concrete Slabs above Grade:
    a. Piping NPS 6 and Smaller:
        1) Galvanized-steel-pipe sleeves for wet areas.
        2) Molded-PE or -PP sleeves for all others.
    b. Piping Larger than NPS 6: Not applicable.

3.4 ESCUTCHEON INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install floor plates for piping penetrations of equipment room floors.

C. Install escutcheons with inside diameter to closely fit around pipe, tube, and insulation of insulated piping and with outside diameter that completely covers opening.

D. Escutcheon schedule:

1. Escutcheons for Exposed New Piping in Finished Areas:
    a. Bare Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    b. Insulated Piping: One-piece, stamped-steel type.
    c. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    d. Escutcheons are not required for concealed piping, piping in unfinished service areas, or piping in equipment rooms.
2. Escutcheons for Exposed Existing Piping:
    a. Bare Piping: Split-casting brass type with polished, chrome-plated finish.
    b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    c. Escutcheons are not required for concealed piping, piping in unfinished service areas, or piping in equipment rooms.

END OF SECTION

SECTION 20 0520 - METERS AND GAUGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Liquid-in-glass thermometers.

B. Thermal wells.

C. Dial-type pressure gages.

D. Gage attachments.

E. Test plugs.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer’s catalog literature for each for each type of product indicated.

1.5 COORDINATION

A. Coordinate installation of meters and gauges with installation of piping and ductwork.

PART 2 PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.

2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.

3. Case Form: Adjustable angle unless otherwise indicated.

4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass.
7. Stem: Aluminum.
8. Stem Length: To suit installation.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMAL WELLS

A. Thermal wells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: Copper nickel.
   4. Material for Use with Steel Piping: Steel.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
   1. Standard: ASME B40.100.
   2. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
   3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   4. Connection: Brass, with NPS 1/4 ASME B1.20.1 pipe threads and bottom-outlet.
   5. Movement: Mechanical, with link to pressure element and connection to pointer.
   6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
   7. Pointer: Dark-colored metal.

8. Window: Glass.
9. Ring: Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass with NPS 1/4 ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Tee or lever handle, Brass quarter-turn ball cock with NPS 1/4 ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: EPDM self-sealing rubber.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install thermal wells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermal wells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermal wells with extension on insulated piping.

D. Fill thermal wells with heat-transfer medium.

E. Install direct-mounted thermometers in thermal wells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Where installing one pressure gauge per pump, provide taps before strainers and on suction and discharge of pump. Connect NPS 1/4 inch piping to gauge.

H. Install valve and snubber in piping for each pressure gauge.

I. Install test plugs in piping tees.

3.2 ADJUSTING

A. After installation, calibrate meters according to manufacturers written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.3 THERMOMETER SCHEDULE

A. Install industrial-style, liquid-in-glass type thermometers in the following locations:
   1. Outlet of each domestic water heater, heat exchanger, and storage tank.
   2. Domestic hot water recirculating header from building.
   3. Header piping to central heating and chilled water equipment.
   4. Other locations detailed on Drawings.

B. Provide the following thermometer scale-ranges:
   1. Domestic Water Piping: 30 to 180 deg F.
   2. Heating Water Piping: 30 to 240 deg F.

3.4 PRESSURE GAUGE SCHEDULE

A. Install direct-mounted, dial-type pressure gauges in the following locations:
   1. Building water service entrance.
   2. Inlet to each expansion tank.
   3. Discharge of each pressure-reducing valve.
   4. Suction and discharge of each heating water pump.
   5. Suction and discharge of each chilled water pump.
   6. Other locations detailed on Drawings.

B. Provide the following pressure gauge scale-ranges:
   1. Domestic Water Piping: 0 to 100 psi.
   2. Heating Water Piping: 0 to 100 psi.

3.5 TEST PLUG SCHEDULE

A. Install test plugs with EPDM self-sealing rubber insert in the following locations:
   1. Inlet and outlet of each hydronic coil.
   2. Inlets and outlets of each heat exchanger.
   3. Other locations detailed on the Drawings.

END OF SECTION

SECTION 20 0525 - GENERAL DUTY VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

D. Drain valves.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer’s catalog literature for each for each type of product indicated.

1.5 COORDINATION

A. Coordinate installation of ball valves, butterfly valves, and check valves with installation of piping.

1.6 STORAGE AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature.

3. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads on threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valves.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: Comply with NSF 61 and NSF 372 for potable-water applications.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Actuator Types: Hand-lever for quarter-turn valves NPS 6 and smaller.

I. Valves in Insulated Piping: Include 2-inch stem extensions/extended necks.

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

1. Conbraco: apollovalves.com.
2. Milwaukee: milwaukeevalve.com.
3. Nibco: nibco.com.

2.2 BALL VALVES

A. Size 2 inch and Smaller: MSS SP-110, Class 150, 600 psi CWP, bronze two-piece body, chrome plated brass or stainless steel ball, TFE seats and stuffing box ring, blow-out proof bronze or stainless steel stem, with lever handle. Suitable for water, oil, or gas (WOG) services. Threaded or soldered ends.

2.3 BUTTERFLY VALVES

A. Size 2-1/2 inch and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, stainless steel stem, aluminum bronze with resilient replaceable EPDM or NBR seat, lever operated with 10-position throttling plate. Lug style or grooved ends capable for use as dead-end service isolation valves at full pressure without the use of additional flange.

2.4 CHECK VALVES

A. Size 2 Inch and Smaller: MSS SP-80, Class 125, wye-pattern swing type, bronze body, bronze trim, renewable TFE seat disc. Soldered or threaded ends.

B. Size 2-1/2 Inch and Larger: MSS SP-71, Class 125, swing type, iron body, bronze trim, bronze seat disc, renewable disc seal and seat. Threaded, flanged, or grooved ends.

C. For vertical lines or pump discharge: MSS-SP126, Class 125, spring-actuated, iron body, bronze trim, bronze disc, renewable seals, and stainless steel spring. Threaded, flanged, or grooved ends.

2.5 DRAIN VALVES

A. Drain valves shall be ball valves as specified herein or ball valves as part of an integral flange isolator product. All drain valves shall be fitted with American standard hose thread fitting with cap and chain.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Spring Loaded Check Valves: In horizontal or vertical position, between flanges.

3.3 VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.

END OF SECTION

SECTION 20 0530 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Thermal shield inserts.

E. Fastener systems.

F. Equipment supports.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer’s catalog literature for each for each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates where applicable.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations, including product data for components.

1.6 QUALITY ASSURANCE

A. General: All materials shall meet or exceed all applicable referenced standards; federal, state, and local requirements, and conform to codes and ordinances of authorities haing jurisdiction.

B. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, Structural Welding Code - Steel.

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer. Retain analysis data, signed and sealed, and submit upon request.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Anvil International
2. Cooper Industries
3. Unistrut Corporation
4. Erico International

2.3 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.4 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

A. Description: Shop or field fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

1. Standard: Comply with MFMA-4.
2. Channels: Minimum 12-gauge, 1-5/8-inch, continuous slotted steel channel with inturned lips and epoxy-coated finish.
3. Channel Nuts: Formed or stamped steel nuts designed to fit into channel slot and, when tightened, prevent slipping along channel.
4. Pipe Clamps: Electro-galvanized carbon steel strut clamp with welded fastener and nylon locknut.
5. Coupling: High-strength thermoplastic polypropylene insulation insert molded to fit clamp halves.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.6 THERMAL SHIELD INSERTS

A. Insert Material: ASTM C533, Type I calcium silicate with 100-psig minimum compressive strength, ASTM C1136 ASJ vapor barrier jacket, and ASTM A527 galvanized steel shield.

1. For Clevis or Band Hangers: Insert and shield shall cover lower half of pipe.
2. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference.
3. Insert Length: Extend 2 inches beyond sheet metal shield .

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded shop or field fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Carbon Steel: ASTM A1011.

B. Structural Steel: ASTM A36, carbon-steel plates, shapes, and bars; black and galvanized.

C. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

D. Grout: ASTM C1107, factory-mixed and packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Coordination: Coordinate installation of hangers and supports with installation of piping, equipment, and ductwork.

B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fastener System Installation: Install for use in lightweight concrete or concrete slabs after concrete is placed and completely cured. Install fasteners according to manufacturer's instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports level, plumb, and true. Plan piping layout accordingly. Do not support piping from other piping. Do not support piping from valves or other devices.

H. Plan and install piping such that insulation clearance to ductwork, conduit, other piping, combustibles, etc is maintained.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and at changes in direction of piping.

K. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Install lateral bracing with pipe hangers and supports to prevent swaying.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Remove welding flux immediately.
3. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in sections specifying piping and ductwork systems and equipment.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Use thermal-hanger shield inserts for insulated piping and tubing. Provide sufficient clearance within the hanger to accommodate continuous insulation.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

H. Building Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
5. C-Clamps (MSS Type 23): For structural shapes.

6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
      a. Horizontal (MSS Type 54): Mounted horizontally.
      b. Vertical (MSS Type 55): Mounted vertically.
      c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.

L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system sections.

END OF SECTION

SECTION 20 0550 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment labels.

B. Pipe and duct labels.

C. Warning labels.

D. Ceiling grid tags.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide manufacturer’s catalog literature for each for each type of product indicated.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve Numbering Schedule: For each piping system to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with ANSI A13.1 for lettering size, length, colors, and viewing angles of identification devices.

1.6 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustic ceilings and similar concealment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Brimar Industries; pipemarkers.com.
2. Carlton Industries; carltonusa.com.
3. Craftmark Pipe Markers; craftmarkid.com
4. Graphic Products; graphicproducts.com
5. Seton Company; seton.com.

2.2 EQUIPMENT LABELS

A. Description: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

1. Color: Black background with white lettering.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 3 by 1 inch.
4. Minimum Letter Size: 1/2 inch. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Contents: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified.

2.3 PIPE AND DUCT LABELS

A. Description: Preprinted, color-coded, fade-resistant, vinyl material with lettering indicating service, and showing flow direction.

1. Colors and Lettering Size: Comply with ANSI A13.1 for piping; White lettering on green background for air ducts.
2. Flow-Direction Arrows: Integral with piping or duct system service lettering to accommodate both directions or as separate unit on each pipe or duct label to indicate flow direction.
3. Adhesive: Contact-type, permanent-adhesive backing, compatible with carbon steel piping, plastic pipe, all service jackets, aluminum jacketing, and galvanized sheet steel.

B. Pipe Label Contents: Include identification of piping using same designations as used on Drawings and arrows indicating flow direction.

C. Duct Label Contents: Include identification of air service using same designations as used on Drawings and arrows indicating flow direction.

2.4 WARNING SIGNS AND LABELS

A. Description: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

1. Color: Red background with white lettering.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content.
4. Minimum Letter Size: 3/4 inch. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Contents: Include caution and warning information plus emergency notification instructions.

2.5 CEILING GRID TAGS

A. Description: Vinyl self-adhesive labels, for installation on ceiling grid for equipment located above lay-in ceiling.

1. Color: Black lettering on a white background.
2. Size: 3/4-inch wide by 3-mil thick, variable length.

B. Label Contents: Include equipment's drawing designation or unique equipment number.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, and paints.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment using fasteners or adhesive.

B. Identify control panels, major control components, fire dampers and smoke dampers.

C. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals in areas of congested piping and equipment.

3.5 DUCT LABEL INSTALLATION

A. Locate duct labels in mechanical rooms near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling systems.

3.6 CEILING TAG INSTALLATION

A. Affix ceiling grid tags to locate valves, dampers, control devices, and other concealed equipment above panel type ceilings. Locate in corner of grid closest to equipment/device.

END OF SECTION

SECTION 20 0590 - TESTING ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of systems and equipment.

B. Balancing Air Systems:

1. Variable-air-volume systems.

C. Balancing Hydronic Piping Systems:

1. Variable-flow hydronic systems.

D. Balancing Plumbing Piping Systems:

1. Domestic hot water flow systems.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

B. Associated Air Balance Council:

1. AABC MN-1 - AABC National Standards for Total System Balance.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

D. National Environmental Balancing Bureau:

1. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

E. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Qualification Data: Submit documentation that the testing and balancing agency and field specialists meet the qualifications specified in the quality assurance article.

1.5 INFORMATIONAL SUBMITTALS

A. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

B. Instrument Calibration Reports: To include instrument type and make, serial number, application, dates of use, and dates of calibration.

C. Field Deficiency Reports: Include defects and deficiencies that will or could prevent proper testing and balancing. Beginning or continuing with the work indicates acceptance of examined conditions.

1.6 CLOSEOUT SUBMITTALS

A. Final Report: Prepare a certified written report to meet the requirements specified in the final report article at the end of this section.

1. Tabulate and divide the report into separate sections for tested systems and balanced systems.
2. The report shall be submitted to the engineer, with adequate time for thorough review, prior to the substantial completion visit.

1.7 QUALITY ASSURANCE

A. TAB Agency Qualifications:

1. An independent company specializing in the measurement, testing, adjusting, and balancing of plumbing and mechanical systems, not affiliated with any other contractor or equipment supplier on the project.
2. Having a minimum of 5-years documented experience with installations of similar size and complexity. Submit a list including reference contacts.
3. Certified by one of the following:
    a. AABC: Associated Air Balance Council: aabchq.com.
    b. NEBB: National Environmental Balancing Bureau: nebb.org.
    c. TABB: Testing, Adjusting, and Balancing Bureau: tabbcertified.org.
4. TAB Field Supervisor and Technician: Employee of the TAB agency and certified by the same organization.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.8 PRE-QUALIFIED TAB SPECIALISTS

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

1. Bighorn Corporation, Billings, MT; (406) 248-5299.
2. Balancing Professionals, Rapid City, SD; (605) 348-8298.
3. Substitutions: See Section 20 0050 for substitution procedures.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one or more of the following:
   1. AABC National Standards for Total System Balance.
   2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
   4. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced, and complete work prior to the date of substantial completion of the project, phases or sub-phases.

C. Where hvac systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling, testing, and inspection procedures with the authorities having jurisdiction.

D. BAS Coordination:
   1. In addition to the settings specified herein, collaborate with the BAS contractor any settings that will be determined in conjunction the TAB Agency. Document these settings in the report. Settings may include but are not limited to: air terminal flow coefficients, damper positions, static and differential pressure setpoints, variable speed drive settings, etc.
   2. The TAB Agency's equipment shall include a PC for interface to the BAS. Utilize operator interface software and any special hardware (cables, signal converters) provided to allow for the PC to interface to the BAS.
   3. The TAB Agency shall engage with the BAS contractor for adequate training so that they can utilize the operator interface without ongoing assistance from the BAS contractor.

E. Minimum Drive Speed:
   1. The minimum fan speed setting within each variable speed drive itself shall be optimized in the field to be as low as possible while avoiding inertial stalling.
   2. The minimum pump speed setting within each variable speed drive itself shall be no less than 30% to protect the seal from premature failure.

3.2 TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5-percent of design for supply systems and plus or minus 10-percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10-percent and minus 5-percent of design t. Adjust outlets and inlets in the space to within plus or minus 10-percent of design.

C. Hydronic Systems: Adjust heating and/or cooling water flow rates to within plus or minus 10 percent of design.

D. Maintaining design pressure relationships shall have priority over the tolerances specified above.

3.3 EXAMINATION

A. Examine the contract documents to become familiar with project requirements and to discover conditions in system designs that may preclude proper testing and balancing of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, manual volume dampers, etc. Verify that locations of these devices are applicable for intended purpose and are accessible.

C. Examine ceiling air plenums used for return or relief air, to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

D. Examine approved equipment submittal performance data including fan curves and pump curves. Relate performance data to project conditions and requirements, to evaluate undesired or unpredicted conditions that may cause reduced capacities in all or part of a system.

E. Examine system and equipment installations and verify that field quality control testing, cleaning, and adjusting specified in individual sections have been performed.

F. Examine equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

G. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

H. Examine strainers and verify that permanent screens with indicated perforations have replaced startup screens.

I. Examine control valves and control dampers for proper installation for their intended function of throttling, diverting, or mixing fluid and/or air flows.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Examine test reports specified in individual system and equipment sections.

3.4 PREPARATION

A. Prepare a test and balance plan that includes the following:

1. Equipment and systems to be tested.

2. Strategies and step-by-step procedures for balancing the systems.
3. Sample forms with specific identification for all equipment.
4. Instrumentation to be used.

B. Perform checks of systems and equipment to verify system readiness for testing and balancing work. At a minimum, include the following:

1. Airside:
    a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    b. Duct systems are complete with terminals installed.
    c. Volume, smoke, and fire dampers are open and functional.
    d. Fans are operating, free of vibration, and rotating in correct direction.
    e. Variable-frequency controller startup is complete and safeties are verified.
    f. Automatic temperature control systems are operational.
    g. Suitable access to balancing devices and equipment is provided.
    h. Clean filters are installed.
2. Hydronics:
    a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
    b. Piping is complete with all coils connected and terminals installed.
    c. Systems are flushed, filled, and air purged. Water treatment is complete.
    d. Control valves are functioning per the sequence of operation.
    e. Shutoff and balance valves are verified to be 100-percent open.
    f. Pumps are started and proper rotation is verified.
    g. Pump gauge connections are installed at inlet and outlet flanges.
    h. Test ports are installed at inlet and outlet piping to coils, valves, and/or strainers.
    i. Variable-frequency controller startup is complete and safeties are verified.
    j. Suitable access to balancing devices and equipment is provided.
    k. Strainers are pulled and cleaned.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Cut insulation at ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for the TAB procedures.

1. After testing and balancing, patch probe holes in ducts with the same material and thickness as used to construct the ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to applicable specifications.

B. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable permanent identification material to show final settings.

C. Measure and report testing and balancing measurements in inch-pound (IP) units only.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Measure and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

C. Pressure drop across filters during balancing shall be simulated to approximately 50-percent loaded condition. After balancing, check motor amperage with the fiters clean.

D. Vary total system air quantities by adjustment of fan speeds. Provide drive changes (sheaves and/or belts) as required. Vary branch air quantities by damper regulation.

E. Adjust for air quantities shown on the drawings with the proper relationship between supply and exhaust established.

F. For variable-air-volume systems, develop a plan to simulate diversity. Full flow in one section of the system may be simulated by temporary restriction of flow to other sections.

G. Determine the best locations in main and branch ducts for accurate airflow measurements.

H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

I. Verify that motor starters are equipped with properly sized thermal protection.

J. Check dampers for proper position to achieve desired airflow path.

K. Check ductwork and equipment for airflow blockages.

L. Check condensate drains for proper connections and function.

M. Check air-handling-unit components for proper seals.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge. Verify that the system is under static pressure control.

2. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point 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. Calibrate and balance each terminal unit for maximum and minimum design airflow:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.

b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

d. Adjust controls so that terminal is calling for minimum and heating airflows.

e. Measure airflow and adjust calibration factor as required for design minimum and heating airflows. Record calibration factors. If no calibration is available, note any deviation from design airflows.

4. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

   a. Set outside air, return air, and relief air dampers for proper position that simulates minimum outdoor air conditions.

   b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.

   c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

   d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

   e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

5. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.

   b. Measure static pressure directly at the fan inlet or through the flexible connection.

   c. Measure static pressure across each component that makes up the air-handling system.

   d. Report any artificial loading of filters at the time static pressures are measured.

6. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.

   b. Verify that terminal units are meeting design airflow under system maximum flow.

7. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

8. Verify final system conditions as follows:

   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.

b. Re-measure and confirm that total airflow is within design.

c. Re-measure final fan operating data, rpms, volts, amps, and static profile.

d. Test system in economizer mode. Verify proper operation and adjust if necessary.

e. Measure and record all operating data.

f. Record final fan-performance data.

g. Mark all final settings.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Where flow-metering devices are not installed, base flow balance on pressure drop or temperature difference across various heat transfer elements in the system. Do not use service or shut-off valves for balancing.

C. For variable-flow systems, develop a plan to simulate diversity. Full flow in one part of the system may be simulated by temporary restriction of flow to other parts.

D. For primary-secondary hydronic systems, balance the primary circuit flow first, then the secondary circuits.

E. In addition to confirming system pressure, all auto-flow or pressure independent control valve circuits hall have their flow measured and documented in the report.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check liquid level in the expansion tank.

I. Check highest vent for adequate pressure.

J. Check flow-control valves for proper position.

K. Check that air has been purged from the system.

3.9 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.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential pressure sensor is located as indicated.

2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through the coils.
2) Determine flow by pump total dynamic head or exchanger pressure drop.
3) Compare flow to that measured by main flow meter, where installed.

b. Measure pump total dynamic head as follows:
1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gauge heights.
4) Verify pump impeller size by measuring the total dynamic head with the discharge valve closed. Note the point on the manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump total dynamic head. Adjust pump discharge valve until design water flow is achieved, with the variable frequency controller at 60 Hz (or manufacturer's max design speed for "smart" pumps).

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.
a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for eac to design water flows.
a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Where applicable, adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:
a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:
a. Measure and balance coils by control valve pressure drop and manufacturer's data.
b. Perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential pressure set point.

7. At completion, open discharge valve 100-percent and allow variable-frequency controller to control system differential pressure setpoint. Record pump data under both conditions.
8. Verify final system conditions as follows:
    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pump operating data, total dynamic head, volts, amps, and static profile.
    c. Mark all final settings.

3.10 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

A. Prepare test reports for pumps and heat exchangers. Obtain approved submittals and manufacturer recommended testing procedures.

B. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

C. Verify that motor starters are equipped with properly sized thermal protection.

D. Check flow-control valves for proper position.

3.11 PROCEDURES FOR CONSTANT-FLOW PLUMBING SYSTEMS

A. Prepare test reports for pumps and heat exchangers. Obtain approved submittals and manufacturer recommended testing procedures. Crosscheck the summation of required heat exchanger flow rates with pump design flow rate.

B. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
    a. Position valves for full flow through the system.
    b. Determine flow by pump total dynamic head or exchanger pressure drop.
    c. Compare flow to that measured by main flow meter, where installed.
2. Measure pump total dynamic head as follows:
    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gauge heights.
    d. Verify pump impeller size by measuring the total dynamic head with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    e. With valves open, read pump total dynamic head. Adjust pump discharge valve until design water flow is achieved.
3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

C. Adjust flow-measuring devices installed in mains and branches to design water flows.
    1. Measure flow in main and branch pipes.
    2. Adjust main and branch balance valves for design flow.
    3. Re-measure each main and branch after all have been adjusted.
D. For systems with pressure-independent valves:
    1. Measure differential pressure and verify that it is within manufacturer's specified range.
    2. Perform temperature tests after flows have been verified.
E. Verify final system conditions as follows:
    1. Re-measure and confirm that total water flow is within design.
    2. Re-measure final pump operating data, total dynamic head, volts, amps, and static profile.
    3. Mark all final settings.

3.12 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, rpm, phase and hertz.
    3. Nameplate and measured voltage, each phase.
    4. Nameplate and measured amperage, each phase.
    5. Starter size and thermal-protection-element rating.
    6. Service factor and frame size.

3.13 PROCEDURES FOR BOILERS

A. Balance water flow through each heat exchanger to within specified tolerances of the indicated flow with all pumps running. Measure and record the following data with each boiler operating at design conditions:
    1. Heat exchanger entering and leaving water temperatures.
    2. Heat exchanger pressure drop and water flow.
    3. Record relief valve pressure setting.
    4. Fan, motor, and motor controller operating data.

3.14 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator 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. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by the chiller manufacturer.
3. Power factor and kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
4. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering and leaving air temperatures.
5. Calculate capacity in tons of cooling and record.

3.15 PROCEDURES FOR AIR COOLED CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure and record entering and leaving air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressors, fans, and motors.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Airflow.
   2. Water flow rate.
   3. Entering and leaving water temperature.
   4. Water pressure drop for air handler coils.
   5. Dry-bulb temperature of entering and leaving air.
   6. Wet-bulb temperature of entering and leaving air for cooling coils.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Airflow.
   2. Entering and leaving air temperature at full load.
   3. Voltage and amperage input of each phase at full load.
   4. Fuse or circuit breaker rating for overload protection.
   5. Calculated kilowatt at full load.
   6. Nameplate data.

C. Measure, adjust, and record the following data for each refrigerant coil:
   1. Airflow.
   2. Dry-bulb temperature of entering and leaving air.
   3. Wet-bulb temperature of entering and leaving air.

3.17 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Confirm that the sequences of operation are in compliance with the Contract Documents.
2. Verify that controllers are calibrated and function as intended.
3. Verify that controller set points are as indicated.
4. Verify the operation of lockout or interlock systems.
5. Verify the operation of valve and damper actuators.
6. Verify that controlled devices are properly installed and connected to correct controller.
7. Verify that controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
8. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Report: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.18 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.
3. Certify validity and accuracy of field data.

B. Report Contents: In addition to certified field-report data, include the following:

1. Manufacturers test data.
2. Pump curves and fan curves.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, excluding shop drawings and product data.

C. Report Data: In addition to form titles and entries, include the following data:

1. Title page with project name, address, and altitude, name and contact information of the TAB agency, project engineer and contractors list, and the report date.
2. Signature of the TAB supervisor who certifies and is responsible for the report.
3. Table of Contents with pages defined for each section of the report.
4. Nomenclature sheets for each item of equipment.
5. Data for terminal units, including manufacturer's name, type, size, and fittings.

6. Notes to explain why certain final data in the body of reports vary from indicated values.
7. Test conditions for fan performance forms including the following:
    a. Conditions of filters.
    b. Cooling coil, wet and dry bulb conditions.
    c. Settings for static pressure controllers.
    d. Face and bypass damper settings at coils.
    e. Settings for outdoor, return, and exhaust air dampers.
    f. Variable frequency controller settings for variable flow systems.
    g. Fan drive settings including percentage of maximum pitch diameter.
    h. Other system operating conditions that affect performance.
8. Test conditions for pump performance forms including the following:
    a. Variable frequency controller settings for variable flow systems.
    b. Settings for differential pressure controllers.
    c. Other system operating conditions that affect performance.
9. Include a detailed description of all settings established in conjunction with the building automation system contractor.

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. Hydronic heating and cooling water 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 and location.
    b. Make, model, and unit size.
    c. Manufacturer's serial number.
    d. Unit arrangement and class.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and adjustments in inches.
    g. Number, make, and size of belts.

h. 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 adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Fan speed in rpm.
    b. Total airflow rate in cfm.
    c. Total system static pressure in inches wg.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:
    a. System identification and location.
    b. Coil make and model number.
    c. Coil type, number of rows, fins per inch.
    d. Face area in square feet.
    e. Circuiting arrangement.
    f. Tube size in NPS.
    g. Tube and fin materials.
2. Test Data (Indicated and Actual Values):
    a. Airflow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.

d. Outdoor air, wet and dry-bulb temperatures in deg F.
e. Return air, wet and dry-bulb temperatures in deg F.
f. Entering air, wet and dry-bulb temperatures in deg F.
g. Leaving air, wet and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant type.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification and location.
b. Make, model number, and size.
c. Manufacturer's serial number.
d. Arrangement and class.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and 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. Number, make, and size of belts.
g. Center-to-center dimensions of sheave, and adjustments in inches.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed in rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.
f. Variable frequency controller setpoints in Hz.

H. Duct Traverse Reports:
    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.
        e. Duct size in inches.
        f. Duct area in square feet.
        g. Indicated airflow rate in cfm.
        h. Indicated velocity in fpm.
        i. Actual airflow rate in cfm.
        j. Actual average velocity in fpm.
        k. Barometric pressure in psig.
        l. Diagram with duct cross-section grid.
I. Air-Terminal-Device Reports:
    1. Unit Data:
        a. System and air-handling unit identification.
        b. Location and zone served.
        c. Apparatus used for test.
        d. Number from system diagram.
        e. Make, type, size, and model number.
        f. Effective area in square feet.
    2. Test Data (Indicated and Actual Values):
        a. Airflow rate in cfm.
        b. Air velocity in fpm.
        c. Preliminary airflow rate as needed in cfm.
        d. Preliminary velocity as needed in fpm.
        e. Final airflow rate in cfm.
        f. Final velocity in fpm.
        g. Space temperature in deg F.
J. System-Coil Reports:
    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. Flow-meter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.

b. Entering-water temperature in deg F.

c. Leaving-water temperature in deg F.

d. Water pressure drop in feet of head or psig.

e. Entering-air temperature in deg F.

f. Leaving-air temperature in deg F.

K. Pump Test Reports:

1. Unit Data:

a. Unit identification, location, and service.

b. Make, model, size, and serial number.

c. Water flow rate in gpm.

d. Water pressure differential in feet of head or psig.

e. Pump speed in rpm.

f. Impeller diameter in inches.

2. Motor Data:

a. Motor make and frame size.

b. Motor horsepower and rpm.

c. Voltage at each connection.

d. Amperage for each phase.

e. Full-load amperage and service factor.

f. Seal type.

3. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.

b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.

d. Full-open flow rate in gpm .

e. Full-open pressure in feet of head or psig.

f. Final discharge pressure in feet of head or psig.

g. Final suction pressure in feet of head or psig.

h. Final total pressure in feet of head or psig.

i. Final water flow rate in gpm.

j. Voltage at each connection.

k. Amperage for each phase.

l. Variable frequency controller setpoints in Hz.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

M. BAS Coordination: Document all settings established in conjunction with the building automation system contractor. Settings may include but are not limited to: flow coefficients, airflow conditions, damper positions, static and differential pressure setpoints, variable speed drive settings and limits, etc.

END OF SECTION

SECTION 20 0710 - MECHANICAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Ductwork insulation.

C. Insulation jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Qualifications Statement: Submit name and qualifications of insulation applicator and name of supervisor for approval within 30-days after award of Contract.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than ten years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, having a mnimum of 5-years experience and approval of the manufacturer.

C. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL723.

1.6 STORAGE AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Store in clean, dry, indoor conditions. Protect from moisture, dirt, dust, and damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Armacell: armacell.us.
2. CertainTeed Corporation: certainteed.com.
3. Johns Manville Corporation: jm.com.
4. Knauf Insulation: knaufusa.com.
5. Owens Corning Corporation: ocbuildingspec.com.
6. Substitutions: See Section 20 0500 for substitution procedures.

B. Source Limitations: Obtain insulation of each type through one source from a single manufacturer.

2.2 PIPING INSULATION

A. Rigid Glass Fiber Insulation: ASTM C547 rigid molded, noncombustible. K value = 0.24 at 75 degrees F. White all service vapor barrier jacket, kraft paper with glass fiber yarn bonded to aluminized film; moisture vapor transmission of 0.02 perm inches. Vapor barier lap adhesive compatible with insulation. ASTM C195 insulating mastic.

B. Flexible Elastomeric Cellular Insulation: ASTM C534 Grade 3 preformed flexible elastomeric cellular rubber insulation. K value = 0.27 at 75 degrees F. Molded tubular material with preformed fittings; no field fabricated fittings. Waterproof vabor barrier adhesive compatible with insulation.

2.3 DUCT INSULATION

A. Flexible Glass Fiber Insulation: ASTM C533 flexible, noncombustibe blanket insulation. K-value = 0.36 at 75 degrees F. Vapor barrier jacket, foil skim kraft paper with glass fiber yarn bonded to aluminized film; moisture vapor transmission of 0.02 perm inches. Secure with 2-inch vapor barrier pressure sensitive tape.

B. Rigid Glass Fiber Insulation: ASTM C612 rigid, non-combustible insulation. K-value = 0.24 at 75 degrees F. Vapor barrier jacket, foil skim kraft paper with glass fiber yarn bonded to aluminized film; moisture vapor transmission of 0.02 perm inches. Secure with 4-inch vapor barrier pressure sensitive tape.

2.4 PIPING INSULATION JACKETS

A. PVC or ABS Plastic: One-piece molded type fitting covers and sheet material, 10-mil thick, white color. Connections with pressure sensitive color matching vinyl tape.

B. Aluminum Jacket: ASTM B209 formed aluminum sheet, 0.016 inch thick, embossed finish, 3/8 inch wide aluminum metal bands. Longitudinal slip joints with 2 inch laps. Die shaped 0.016 inch thick fitting covers.

2.5 DUCT INSULATION JACKETS

A. Aluminum Jacket: ASTM B209 formed aluminum sheet, factory applied polyethylene and kraft paper moisture barrier inside, 0.016-inch thick, embossed finish, 3/8-inch wide aluminum metal bands. Longitudinal slip joints with 2-inch laps.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Verify that piping and/or ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

C. Maintain ambient conditions required by manufacturers of each product.

D. Maintain temperature before, during, and after installation for minimum of 24-hours.

3.2 PIPING INSULATION INSTALLATION

A. Install in accordance with NIA and MICA insulation standards and the manufacturer's instructions.

B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including all fittings, valves, unions, flanges, strainers, pump bodies, drain sump bodies, etc.

C. Insulated pipes conveying fluids above ambient temperature and less than 140-deg F: Do not insulate flanges and unions at equipment. Bevel and seal ends of insulation.

D. Insulated pipes conveying fluids above ambient temperature and greater than 140-deg F: Insulate entire system including fittings, valves, unions, flanges, strainers, etc.

E. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.

F. Hydrous calcium silicate inserts shall be used with all piping 2-inch diameter or larger when supported with hangers or all piping diameters when strut mounted. Use same thickness and contour as adjoining insulation, installed under finished jacket.

G. Galvanized steel shields shall be installed between all pipe hangers and insulation. Tape all shields in place with pressure sensitive color matching vinyl tape.

H. Continue pipe insulation through walls, sleeves, hangers, and other penetrations. Finish at clamps, protrusions, and other interruptions. Bevel and seal open ends of insulation.

I. Where piping is exposed, locate insulation and cover seams in the least visible locations. Cover all insulation with protective PVC or aluminum covers within 10-ft of the floor (or as noted).

J. Exterior Applications: Insulate fittings, joints, and valves with pre-formed insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Seal weather tight.

K. Extend insulation into and within all equipment enclosures, including chillers, air handlers, etc.

L. Insulate all above grade storm drainage piping, including roof drain sump bodies.

M. Insulate all plumbing vent piping within 10-feet of the exterior penetration.

3.3 DUCT INSULATION INSTALLATION

A. Install in accordance with NIA and MICA insulation standards and the manufacturer's instructions.

B. Insulate all concealed supply air ducts where not lined. Insulate entire system including fittings, joints, flanges, dampers, flexible connections, and expansion joints. Do not wrap exposed ducts.

C. Install without sag on underside of duct. use adhesive and/or mechanical fasteners where necessary. Lift ducts off trapeze hangers and insert insulation spacers.

D. Secure insulation with vapor barrier and seal joints with vapor barrier tape to match the jacket. Seal vapor barrier penetrations with mechanical fasteners and vapor barrier adhesive.

E. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

F. Insulate all relief or exhaust air ducts within 10-ft of an exterior wall or roof opening.

G. Insulate all rectangular ducts within mechanical spaces with rigid insulation only.

H. Exterior Applications: Build up and slope insulation on the top of ductwork to allow water-shed and prevent ponding. Cover insulation with caulked aluminum jacket with seams located on the bottom side of horizontal duct sections. Seal weather tight.

3.4 PIPE INSULATION SCHEDULES

A. Indoor Domestic Cold Water:

1. Glass fiber pipe insulation:

    a. All pipe sizes: 1.0-inch thick.

B. Indoor Domestic Hot and Recirc Water:

1. Glass fiber pipe insulation:

    a. All pipe sizes: 1.0-inch thick.

C. Indoor Domestic Water Pex Piping:

1. Flexible Elastomeric Pipe Insulation:

    a. All pipe sizes: 1.0-inch thick.

D. Indoor Storm Drainage Piping:

1. Glass Fiber Pipe Insulation:

a. All pipe sizes: 0.5-inch thick.

E. Indoor Sanitary Vent Piping:

1. Glass Fiber Pipe Insulation:

a. All pipe sizes: 0.5-inch thick.

F. Indoor Heating Water 200F and below:

1. Glass fiber pipe insulation:

a. Pipe size 4.0-inch and smaller: 1.0-inch thick.

b. Pipe size 5.0-inch to 6.0-inch: 1.5-inch thick.

G. Indoor Chilled Water 60F and below:

1. Glass fiber pipe insulation:

a. Pipe size 4.0-inch and smaller: 1.0-inch thick.

b. Pipe size 5.0-inch to 6.0-inch: 1.5-inch thick.

H. Refrigerant Suction and Liquid Piping:

1. Flexible elastomeric cellular pipe insulation:

a. All pipe sizes: 0.75-inch thick.

3.5 DUCT INSULATION SCHEDULES

A. Combustion Air Duct:

1. None.

B. Outside Air Ducts:

1. Rigid glass fiber duct insulation: 2.0-inch thick.

C. Supply Air Ducts:

1. Flexible glass fiber duct insulation: 1.5-inch thick.

2. Rigid glass fiber duct insulation: 2.0-inch thick.

D. Supply Ducts After Terminal Boxes:

1. Flexible glass fiber duct insulation: 1.0-inch thick.

E. Exhaust Air Ducts:

1. Flexible glass fiber duct insulation: 1.0-inch thick.

F. Ducts Within Mechanical Rooms:

1. Rigid glass fiber duct insulation: 2.0-inch thick.

END OF SECTION

DIVISION

21

FIRE SUPPRESSION

SECTION 21 1313 - WET-PIPE SPRINKLER SYSTEMS

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 AND DESCRIPTION

A. This project consists of the construction of a new two story building with a walkout basement. The building consists of an approximately 29,500 sqft facility in Rock Springs, Wyoming. The building will be protected by two fire suppression systems: a preaction system protecting a data center room and a wet system protecting the remaining portions of the building. The exterior canopies are constructed of limited combustible materials and do not require suppression. The building is small with a single operator that zoning per floor is not required.

B. Fire Suppression System Scope of Work:

1. The scope of work includes providing a new automatic fire sprinkler systems. The fire sprinkler system will be fed from a new share 6-inch water line. The contractor's scope of work will begin at 5'-0 outside the foundation wall. Contractor to provide a 2-inch outlet for domestic water use. A new backflow preventer and sprinkler system risers will be installed in the basement mechanical room. The sprinkler system will be composed of three (3) sprinkler zones that serve the building.

C. The Work specified in this contract consists of furnishing all management, supervision, labor, materials, tools, equipment, services, testing and incidentals for the construction of the Work indicated in the contract documents and these specifications.

D. Change Orders:

1. The Contractor will be required to submit a proposal for each change order.
2. The Contractor shall not proceed on any change notice work until a change order is issued.

E. Section includes:

1. Performance requirements.
2. Steel pipe and fittings.
3. Sprinkler piping specialties.
4. Sprinklers.
5. Pipe joining materials.
6. Listed fire protection valves.
7. Trim and drain valves.
8. Specialty valves.

9. Backflow Preventer.
10. Fire department connections.
11. Sprinkler specialty pipe fittings.
12. Alarm devices.
13. Pressure gauges.

F. Include all design, fabrication, and installation of all wet-pipe fire protection systems and all fire alarm interfaces in accordance with the project documents. Wiring of fire alarm devices is by others. The Fire Protection Work Contractor (FPWC) shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and any contract documents, the most stringent requirement shall apply.

1.3 REFERENCE STANDARDS

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 edition is the current one at the time of commencement of the Work.

B. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply unless specifically excluded by local amendments.

C. 2024 International Building Code (IBC) as adopted and amended by the City of Rock Springs and the State of Wyoming.

D. 2024 International Fire Code (IFC) as adopted and amended by the City of Rock Springs and the State of Wyoming.

E. National Fire Protection Association (NFPA)

1. NFPA 13 - Standard for the Installation of Sprinkler Systems, 2022 Edition.
2. NFPA 24 - Standard for the Installation of Private Fire Service Mains and their Appurtenances, 2022 Edition.
3. The most stringent interpretations shall apply. All appendices and/or Annexes shall apply.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate installation of fire suppression systems with architect and design team. Installation above and beyond minimum code / installation standard compliance may be asked for. Contractor to receive approval before installation of system to begin.

2. Coordinate installation of fire suppression systems with the other trades. Fire suppression piping to avoid HVAC unit clearances.

1.5 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

B. Working plans as used in this Section refer to documents, including drawings and calculations, prepared pursuant to requirements of the IFC, IBC, NFPA 13, the City of Rock Springs, and the State of Wyoming agencies for obtaining approval of authority having jurisdiction.

C. Other definitions for fire protection systems are included in referenced NFPA standards.

1.6 REQUIRED SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Provide complete drawings per NFPA 13 Chapter 27, stamped by a Wyoming registered Professional Engineer.

2. Include plans, elevations, sections, and attachment details.

1.7 INFORMATIONAL SUBMITTALS

A. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

B. Contractor to obtain fire-hydrant flow test report dated within 12 months per NFPA 13.

C. Field Test Reports and Certificates:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

2. Welding certificates.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.9 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer to design wet-pipe sprinkler systems.

1. Contractor to obtain fire-hydrant flow test information for design of system.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent or 10 PSI, whichever is greater, including losses through water-service piping, valves, and backflow preventers or as required by the local authority having jurisdiction.

b. Sprinkler Occupancy Hazard Classifications:

1) Entry, Corridors, Offices, Restrooms: Light Hazard

2) Data/IT Equipment, Electrical, Mechanical Rooms, etc.: Ordinary Hazard, Group 1

3) Storage Rooms: Ordinary Hazard, Group 1 minimum or per contents and storage arrangement in accordance with NFPA 13, whichever is more restrictive.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Densities according to NFPA 13.

4. Maximum Protection Area per Sprinkler:

a. According to UL listing.

b. According to NFPA 13 requirements unless otherwise indicated.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.

b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:

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

a. Anvil International, Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. or approved equal.

2. Pressure Rating: 175-psig minimum.

3. Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anvil International, Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. or approved equal.
2. Standard: UL 213
3. Pressure Rating: 175-psig minimum
4. Body Material: Ductile-iron housing
5. Type: Weld-o-lets or thread-o-lets
6. Configurations: ductile-iron housing
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Gateway Tubing, Inc.
    b. FlexHead Industries, Inc.
    c. Victaulic Company.
    d. or approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum
5. Size: Same as connected piping, for sprinkler.

2.4 SPRINKLERS

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.

4. Viking Corporation.
5. or approved equal.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Coordinate final finishes with project team. Brass/Bronze in nonpublic applications. Refer to accompanying drawings for additional information related to sprinkler head finishes.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

G. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.
3. Install on all heads below 7’-0

H. Refer to accompanying drawings for additional information regarding sprinkler finishes and guard requirements.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 LISTED FIRE PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.

2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, 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:
    a. Anvil International, Inc.
    b. Victaulic Company.
    c. Or approved equal.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 and larger: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, 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:
    a. Fivalco Inc.
    b. Global Safety Products, Inc.
    c. Milwaukee Valve Company.
    d. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Check Valves:
1. Manufacturers: Subject to compliance with requirements, 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:
    a. Anvil International, Inc.
    b. Fire-End & Croker Corporation.
    c. Mueller Co.; Water Products Division.
    d. Reliable Automatic Sprinkler Co., Inc.
    e. Victaulic Company.
    f. Or approved equal.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Milwaukee Valve Company.
    b. NIBCO INC.
    c. United Brass Works, Inc.
    d. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Milwaukee Valve Company.
    b. Mueller Co.; Water Products Division.
    c. NIBCO INC.
    d. Tyco Fire & Building Products LP.
    e. United Brass Works, Inc.
    f. Watts Water Technologies, Inc.
    g. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

G. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Anvil International, Inc.
    b. Milwaukee Valve Company.
    c. NIBCO INC.
    d. Tyco Fire & Building Products LP.
    e. Victaulic Company.
    f. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
    a. Valve Type: Ball or butterfly.
    b. Body Material: Bronze.
    c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
    a. Valve Type: Butterfly.
    b. Body Material: Cast or ductile iron.
    c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch or visual indicating device.

H. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, 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:
    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Mueller Co.; Water Products Division.
    d. NIBCO INC.
    e. Tyco Fire & Building Products LP.
    f. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.

6. End Connections: Flanged or grooved.

I. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, 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:
   a. Kennedy Valve; a division of McWane, Inc.
   b. Mueller Co.; Water Products Division.
   c. NIBCO INC.
   d. Tyco Fire & Building Products LP.
   e. Or approved equal.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

2.7 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.
   c. Or approved equal.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
   a. Anvil International, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. NIBCO INC.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.

f. Watts Water Technologies, Inc.

g. Or approved equal.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, 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:

a. Fire Protection Products, Inc.

b. United Brass Works, Inc.

c. Or approved equal.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, 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.

a. Southern Manufacturing Group.

b. Or approved equal.

2.8 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

b. High-Pressure Piping Specialty Valves: 250 psig minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, 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:

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. Viking Corporation.

e. Or approved equal.

2. Standard: UL 193.

3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Or approved equal.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.9 BACKFLOW PREVENTER

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ames Fire & Waterworks.
    b. FEBCO.
    c. WATTS.
    d. Or approved equal.
2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: Per manufacture’s flow curve, through middle one-third of flow range.
5. Size: As hydraulic calculations require.
6. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved, steel with interior lining complying with AWWA C550 or that is FDA approved, or stainless steel.
7. End Connections: Flanged or Grooved.
8. Configuration: Designed for straight through flow.

9. Accessories: OS&Y gate or butterfly valves with flanged ends on inlet and outlet.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire Department Connection:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. Fire-End & Croker Corporation.
    d. Tyco Fire & Building Products LP.
    e. Or approved equal.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR"
12. Finish: Polished chrome plated, Rough brass or bronze or Rough chrome plated to be approved by Owner and Architect prior to purchase and installation.
13. Outlet Size: NPS 4 .

2.11 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Anvil International, Inc.
    b. National Fittings, Inc.
    c. Tyco Fire & Building Products LP.

d. Victaulic Company.

e. Or approved equal.

2. Standard: UL 213.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, 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:

a. AGF Manufacturing Inc.

b. Reliable Automatic Sprinkler Co., Inc.

c. Tyco Fire & Building Products LP.

d. Victaulic Company.

e. Or approved equal.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, 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:

a. Elkhart Brass Mfg. Company, Inc.

b. Fire-End & Croker Corporation.

c. Potter Roemer.

d. Or approved equal.

2. Standard: UL 199.

3. Pressure Rating: 175 psig.

4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. AGF Manufacturing Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Viking Corporation.
    e. Or approved equal.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. CECA, LLC.
    b. Corcoran Piping System Co.
    c. Merit Manufacturing; a division of Anvil International, Inc.
    d. Or approved equal.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Fivalco Inc.
    b. FlexHead Industries, Inc.
    c. Gateway Tubing, Inc.
    d. Or approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.12 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Watts.
    b. Potter Electric Signal Co.
    c. System Sensor.
    d. Or approved equal.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig
7. Design Installation: Horizontal or vertical.

C. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, 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:
    a. Potter Electric Signal Company.
    b. System Sensor; a Honeywell company.

c. Or approved equal.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.13 PRESSURE GAUGES

A. Manufacturers: Subject to compliance with requirements, 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:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.
5. Or approved equal.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 300 psig.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping.

B. Install backflow preventer pressure gauge, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans. Note the locations for the riser on the piping drawings. **Note** in the basement storage room, mains should be routed on the East wall unless coordinated elsewhere.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping where required. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads.

   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

   1. General requirements: Install in vertical position for proper direction of flow, in main supply to system.

   2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventer of type, size, and capacity indicated on fire sprinkler riser assembly. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

3.8 FIRE DEPARTMENT CONNECTION

A. Install wall-type, fire department connections.

B. Install yard-type, fire department connections in concrete slab support.

C. Install automatic (ball drip) drain valve at each check valve for fire department connection.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded or grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller shall be one of the following:

1. Schedule 40, black-steel pipe with threaded ends; mailable or cast-iron threaded fittings; and threaded joints.

2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 10 shall be one of the following:

1. Schedule 40, black-steel pipe with roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright style sprinklers.

2. Rooms with Suspended Ceilings: Recessed or fully concealed sprinklers.

3. Wall Mounting: Sidewall style sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Brass, with factory-painted white cover plate or black cover plate if in a wood plank ceiling.

2. Flush Sprinklers: White polyester, with painted white escutcheon or Black with black escutcheon if in a wood plank ceiling.

3. Recessed Sprinklers: White Polyester, with painted white escutcheon or Black with black escutcheon if in a wood plank ceiling.

4. Upright Sprinklers: Chrome plated Painted in finished spaces exposed to public view; rough bronze in unfinished spaces not exposed to public view.

END OF SECTION 211313

SECTION 21 1319 - – PREACTION SPRINKLER SYSTEMS

GENERAL

1.1 RELATED DOCUMENTS

A. Related Documents:

1. Drawings and general provisions of the contract including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to

1.2 SUMMARY AND DESCRIPTION

A. This project consists of the construction of a new two story building with a walkout basement. The building consists of an approximately 29,500 sqft facility in Rock Springs, Wyoming. The building will be protected by two fire suppression systems: a preaction system protecting a data center room and a wet system protecting the remaining portions of the building. The exterior canopies are constructed of limited combustible materials and do not require suppression. The building is small with a single operator that zoning per floor is not required.

B. Fire Suppression System Scope of Work:

1. The scope of work includes providing a new automatic fire sprinkler systems. The fire sprinkler system will be fed from a new share 6-inch water line. The contractor's scope of work will begin at 5'-0 outside the foundation wall. Contractor to provide a 2-inch outlet for domestic water use. A new backflow preventer and sprinkler system risers will be installed in the basement mechanical room. The sprinkler system will be composed of three (3) sprinkler zones that serve the building.

C. The Work specified in this contract consists of furnishing all management, supervision, labor, materials, tools, equipment, services, testing and incidentals for the construction of the Work indicated in the contract documents and these specifications.

D. Change Orders:

1. The Contractor will be required to submit a proposal for each change order.
2. The Contractor shall not proceed on any change notice work until a change order is issued.

E. Include all design, fabrication, and installation of all fire protection systems and all fire alarm interfaces in accordance with the project documents. Wiring of fire alarm devices is by others. The Fire Protection Work Contractor (FPWC) shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and any contract documents, the most stringent requirement shall apply.

1.3 REFERENCE STANDARDS

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 edition is the current one at the time of commencement of the Work.

B. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply unless specifically excluded by local amendments.

C. 2024 International Building Code (IBC) as adopted and amended by the City of Rock Springs and the State of Wyoming.

D. 2024 International Fire Code (IFC) as adopted and amended by the City of Rock Springs and the State of Wyoming.

E. National Fire Protection Association (NFPA):

1. NFPA 13 - Standard for the Installation of Sprinkler Systems, 2022 Edition.
2. NFPA 24 - Standard for the Installation of Private Fire Service Mains and their Appurtenances, 2022 Edition.
3. The most stringent interpretations shall apply. All appendices and/or Annexes shall apply.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate installation of fire suppression systems with architect and design team. Installation above and beyond minimum code / installation standard compliance may be asked for. Contractor to receive approval before installation of system to begin.
2. Coordinate installation of fire suppression systems with the other trades. Fire suppression piping to avoid running directly above data racks, scientific equipment and to avoid HVAC unit clearances.

1.5 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Sprinkler system piping designed to operate at working pressure of 175-psig maximum.

B. Working plans as used in this Section refer to documents, including drawings and calculations, prepared pursuant to requirements of the IFC, IBC, NFPA 13, and for obtaining approval of authority having jurisdiction.

C. Other definitions for fire protection systems are included in referenced NFPA standards.

1.6 REQUIRED SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

    a. **Clearly indicate the exact model of each component to be provided. Include manufacturer's installation Instruction for components being provided under this section.**

B. Shop Drawings: For sprinkler systems.

1. Provide complete drawings per NFPA 13 Chapter 23 required for the construction, commissioning, and maintenance of the system including detailed pipe layout, hangers and supports, piping components, valve and sprinkler head locations, and accessories. Drawings to be stamped by a Wyoming registered Professional Engineer.

2. Include plans, elevations, sections, and attachment details.

C. Calculations: The Subcontractor shall produce and submit detailed hydraulic calculations to prove that the system has been designed in accordance with NFPA 13. Calculations to be stamped by a Wyoming registered Professional Engineer.

1.7 INFORMATIONAL SUBMITTALS

A. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

B. Fire-hydrant flow test report dated with-in 12 months.

C. Field Test Reports and Certificates:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

2. Welding certificates.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinkler systems and specialties to include in emergency, operation, and maintenance manuals for components of the system.

B. Project Record Documents: Submit electronic files developed for this project including shop drawings and calculations. The shop drawings shall be revised to show the "as-built" conditions including actual locations of system components and affected equipment including piping, sprinkler heads, risers, laterals, supports, and points of connection.

1.9 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with

sprinklers and wrench for each type of sprinkler used on Project. **Include required list of sprinklers in the cabinet in accordance with NFPA 13

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.11 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer to design wet-pipe sprinkler systems.

1. Contractor to obtain fire-hydrant flow test information for design of system.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent or 10 PSI, whichever is greater, including losses through water-service piping, valves, and backflow preventers or as required by the local authority having jurisdiction.

b. Sprinkler Occupancy Hazard Classifications:

1) Entry, Corridors, Offices, Restrooms: Light Hazard

2) Data/IT Equipment, Electrical, Mechanical Rooms, etc.: Ordinary Hazard, Group 1

3) Storage Rooms: Ordinary Hazard, Group 1 minimum or per contents and storage arrangement in accordance with NFPA 13, whichever is more restrictive.

3. Minimum Density for Automatic-Sprinkler Piping Design:
    a. Densities according to NFPA 13.
4. Maximum Protection Area per Sprinkler:
    a. According to UL listing.
    b. According to NFPA 13 requirements unless otherwise indicated.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 SYSTEM DESCRIPTION

A. The double interlock pre-action, dry-pipe sprinkler system shall be a fixed water type fire protection sprinkler system, pre-action type which automatically controls the water supply to fusible sprinkler heads for control of fire. Valve to be an electric / pneumatic release. No flexible drop sprinkler heads will be allowed.

B. The sprinkler piping system in the protected area shall remain dry until a fire condition is sensed and shall be monitored with pressurized air. Should a leak occur in the piping system, an alarm shall sound, but water shall not enter the piping system until a fire condition is sensed.

2.3 PIPE AND FITTINGS

A. Buried Piping: Ductile iron.

B. Schedule 40, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed cut grooved for project.
    1. “Dyna Flow”, “Eddy Pipe”, “Super Flow” and/or similar products which are not true schedule 40 thickness will NOT be allowed.

C. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
    1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
        a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
        b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
    2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:

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

a. Anvil International, Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. or approved equal.

2. Pressure Rating: 175-psig minimum.

3. Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 PIPING SPECIALTIES

A. Branch Outlet Fittings:

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

a. Anvil International, Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. or approved equal.

2. Standard: UL 213

3. Pressure Rating: 175-psig minimum

4. Body Material: Ductile-iron housing

5. Type: Weld-o-lets or thread-o-lets

6. Configurations: ductile-iron housing

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Exposed-Type, Fire Department Connection:

1. Manufacturers: Subject to compliance with requirements, 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:

a. Elkhart Brass Mfg. Company, Inc.

b. Croker Corporation.

c. Tyco Fire & Building Products LP.

d. Or approved equal.

2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Automatic Drain: 3/4-inch automatic drip connected to drain,
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, wall type.
10. Outlet: Back, with pipe threads.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR" or “Sprinkler - Fire Department Connection.”
13. Finish: Polished chrome plated, rough brass or rough chrome plated to be approved by Owner and Architect prior to purchase and installation.

2.5 LISTED FIRE PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, 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:

a. Anvil International, Inc.

b. Victaulic Company.

c. Or approved equal.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.

5. Valves NPS 3 and larger: Ductile-iron body with grooved ends.

C. Check Valves:

1. Manufacturers: Subject to compliance with requirements, 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:
    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Or approved equal.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

D. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, 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]:
    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
    a. Valve Type: Ball or butterfly.
    b. Body Material: Bronze.
    c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
    a. Valve Type: Butterfly.
    b. Body Material: Cast or ductile iron.
    c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch or visual indicating device.

E. Deluge / Preaction Valves:

1. Valve, complete with releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoids. Systems provided with solenoids only, without this mechanical latching device, shall not be assumed acceptable but must be submitted for approval. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
2. Manufacturers: Subject to compliance with requirements, 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]:
    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Viking Corporation.
    e. or approved equal.
3. Standard: UL 260.
4. Design: Electrically operated, differential-area type.
5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.

2.6 SPRINKLER HEADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Reliable Automatic Sprinkler Co., Inc.
    2. Tyco Fire & Building Products LP.
    3. Victaulic Company.
    4. Viking Corporation.
    5. or approved equal.
B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
D. Automatic Sprinklers with Heat-Responsive Element:
    1. Nonresidential Applications: UL 199
    2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
E. Sprinkler Finishes: Coordinate final finishes with project architect. Basis of design shall be the following:

1. Suspended Ceiling Type: Semi-recessed or Concealed pendant with white finish, with matching escutcheon.
2. Exposed Area Type: Standard upright type with brass finish.
3. Sidewall Type: White finish with matching escutcheon.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

G. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.
3. Install on all heads below 7'-0, in sensitive areas, or areas subject to damage.

2.7 AIR COMPRESSOR

A. Single unit, electric-motor driven, ASME-rated horizontal receiver tank, air-pressure-operated electric switch, motor, motor starter, safety valves, oil-less, piston compressor, including gauge, check valves, automatic tank drain, muffler, filter, belt guard, and controls.
1. Compressor may be floor mounted, or riser mounted.
2. Compressor to be sized in accordance with NFPA 13 and capable of restoring normal air pressure in the system with-in 30 minutes.
3. Single-phase motor shall have internal thermal protection.
4. Double interlock preaction system shall only require between 10 and 28 psi (0.7 to 1,9 bar) supervisory pressure for proper setting of the low-pressure pneumatic actuator in accordance with the manufacturer's instructions.
5. Air supply shall be equipped with an automatic pressure maintenance device capable of maintaining a constant system pressure regardless of pressure fluctuations in the compressed air source, or system piping.

B. Air Compressor to be equipped with an air dryer that is listed for use with the air compressor it serves.

2.8 RELEASING CONTROL PANEL

A. The control panel shall incorporate all necessary relays, timers, switches, alarms, and trouble lights necessary for system operation. The panel shall be factory prewired.

2.9 DETECTION SYSTEM

A. Detection System: Spot type smoke detection system. See electrical and fire alarm drawings for more details.

2.10 BUILDING FIRE ALARM INTERFACE:

A. Each pre-action control panel shall provide a trouble signal output to the Building Fire Alarm System (wiring by fire alarm contractor) whenever a trouble condition exists in the pre-action system.

B. Each pre-action control panel shall provide a trouble signal output to the Building Fire Alarm System (wiring by fire alarm contractor) whenever a loss of air condition exists in the pre-action system.

C. The pre-action control panel shall provide an alarm signal output to the Building Fire Alarm System (wiring by fire alarm contractor) whenever there is waterflow in the pre-action system.

D. The activation of both the detection condition AND the opening of an automatic sprinkler are necessary to cause the water discharge.

E. The activation of an electrical detector alone will sound an alarm and activate alarm contacts for auxiliary functions but will not cause the system to fill with water.

F. The opening of an automatic sprinkler OR damage to system piping without the detection condition satisfied will activate the very low air pressure switch, sound an alarm, and activate alarm contacts for auxiliary functions but will not cause the system to fill with water.

G. Activation of BOTH the detection condition AND the opening of an automatic sprinkler will activate the solenoid valves, open the deluge valve, and cause water to discharge. This will sound an alarm and activate alarm and water flow contacts for auxiliary functions.

H. Each valve which controls the flow of sprinkler system water shall be monitored by the Building Fire Alarm System (wiring by fire alarm contractor).

2.11 PRESSURE GAUGES

A. Provide gauges on system as required by NFPA 13 and manufacturer requirements.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. AGF Manufacturing, Inc.
    b. AMETEK, Inc.
    c. As provided by manufacturer of the valve
    d. or approved equal.
2. Standard: UL 393.
3. Dial Size: 3-1/2- to 4-1/2-inch diameter.
4. Pressure Gauge Range: 0- to 250-psig minimum
5. Label: Include "WATER" label on dial face.

EXECUTION

3.1 PREPARATION

A. Coordinate work of this section with other affected work and final layout of racking.

B. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

C. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping.

B. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans. Note the locations for the riser on the piping drawings.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping where required. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions or grooved couplings adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Pipe hangers specified in NFPA 13 meet minimum pipe hanger requirements and may be inadequate in areas where seismic events are likely or for special conditions.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

N. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

R. Place pipe runs to minimize obstructions to other work.

S. Place piping in concealed spaces above finished ceilings.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

3.5 INSTALLATION - AIR COMPRESSOR

A. Coordinate electrical needs with electrical contractor upon selection of air compressor.

B. Pipe receiver tank drain to nearest floor drain.

3.6 SPRINKLER INSTALLATION

A. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.

B. Ensure sprinkler installation location is not directly above a data rack, scientific equipment, or electrical equipment.

C. Ensure that concealed sprinkler cover plates do not receive field paint finish.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Test system control sequence for operation with fire alarm contractor.

3.8 CLEANING

A. Unsure new underground piping has been flush of foreign matter in accordance with NFPA 24.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

C. Submit a completed Subcontractor’s material and test certificates prior to requesting approval of the installation by design team.

END OF SECTION 211319

DIVISION

22

PLUMBING

SECTION 22 1110 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Domestic water piping and fittings.

B. Unions, flanges, and couplings.

C. Hangers and supports.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Include data on pipe and fittings, joining materials, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1. Piping must be clearly identified with intended service and range of sizes indicated.

2. Valves and other accessories shall be identified to correspond with the piping submittals.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports: Provide evidence of piping system pressure tests. Include date, section tested, test pressure, and results.

B. Test Reports: Provide evidence of disinfection and bacteriological results of each outlet tested conforming to standards of State and Federal safe drinking water acts.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping and valves.

1.7 QUALITY ASSURANCE

A. Provide piping, pipe fittings, solder and flux, etc, that comply with NSF 61 and NSF 372 for maximum lead content. Label pipe and fittings.

B. Identify pipe with marking including size, material classification, potable water certification, and water pressure rating.

1.8 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 delivered to the jobsite. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 WATER PIPING, BELOW GRADE

A. Polyethylene Pipe: ASTM D3035 CTS 200 psi.

1. Fittings: ASTM D2683 socket fusion type.
2. Joints: Fusion welded.

B. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: Ductile or grey iron, standard thickness.
2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods.

2.2 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88, Type L, hard drawn.

1. Solder Fittings and Joints: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze. ASTM B32, alloy Sn95 solder.
2. Mechanical Press Fittings: ASME B16.51 cast copper alloy, wrought copper, or wrought copper alloy press-connect pressure fittings. EPDM synthetic rubber sealing elements.

B. Cross-Linked Polyethylene Pipe (PEX): ASTM F876 or ASTM F877.

1. Fittings: Lead-free brass or engineered polymer.
2. Joints: Mechanical compression fittings.

2.3 EQUIPMENT DRAINS

A. Copper Tube: ASTM B88, Type M.

1. Fittings: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper.

2. Solder Joints: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.

2. Joints: Solvent welded in accordance with ASTM D2855.

2.4 UNIONS FLANGES AND COUPLINGS

A. Unions for Pipe Sizes 2 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.

2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 2-1/2 Inches and Over:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

2.5 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Hangers for Pipe Sizes 1/2 to 2-inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2-1/2 to 6-inch: Carbon steel, adjustable, clevis.

D. Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Supports: Slotted channel framing with insulated strut clamps.

F. Vertical Supports: Steel riser clamps.

G. Hanger Rods: Mild steel continuous threaded.

2.6 DRAIN VALVES

A. Drain valves shall be ball valves as specified herein or ball valves as part of an integral flange isolator product.

B. All drain valves shall be fitted with American standard hose thread fittings and blind hose caps.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine piping interior for cleanliness, freedom from foreign matter, and corrosion.

B. Remove scale and dirt on inside and outside before assembly.

C. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

D. Prepare piping connections to equipment with flanges or unions.

E. Protect open ends of pipe with temporary plugs or caps.

F. Do not install below grade piping when bedding is wet or frozen.

3.2 GENERAL PIPING 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. Drawing plans indicate general location and arrangement of piping systems. Install piping as closely as possible to that indicated unless deviations to layout are approved.

C. Route piping in an orderly manner, parallel and perpendicular to building structure.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install firestopping to preserve fire resistance rating of partitions and other elements.

G. Install piping free of sags and bends. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Sleeve all piping passing through partitions, walls, and floors. Install escutcheons on exposed, finished side of penetrations.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Provide galvanized hangers and supports and accessories in locations exterior to the building.

L. Provide access doors where valves and fittings are not exposed or otherwise inaccessible.

M. Install piping to permit valve servicing. Install valves with stems upright or horizontal, not inverted.

N. Where buried non-metallic piping is used, install 10-gauge solid copper tracer wire suitable for direct bury with the piping.

O. Install piping adjacent to equipment to allow service and maintenance access. Install unions and shut-off valves at all equipment inlets and outlets. Provide appropriate equipment grounding.

P. Wall mounted piping is permitted only where indicated, and shall be secured to 12-gauge 1-5/8 inch slotted channel framing with insulated strut clamps.

Q. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

3.3 PLUMBING PIPING INSTALLATION

A. Install water piping to ASME B31.9.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.

E. Provide flow controls in each circuit of water recirculating systems.

F. Slope water piping at a minimum of 1/32-inch per foot and arrange to drain at low points.

G. Install piping penetrating roofed areas to maintain integrity of roof assembly.

H. Provide support for utility meters in accordance with requirements of utility companies.

I. Provide brass nipples at all domestic piping equipment connections. Galvanized piping is not permitted.

J. Exposed accessories beneath sinks and lavatories shall include chrome plated brass p-traps and extensions, quarter-turn angle stops, and braided stainless steel flexible supplies.

K. Pex Piping Limitations:

1. The use of pex piping shall be limited to 1-inch size and below, serving vertical run-outs to individual fixtures or single bathrooms groups within the wall framing and downstream of isolation valves, with firmly secured copper ell stub-outs at the fixtures.

2. Main branch piping shall not be installed with pex. Do not install pex piping to flush valve water closets and urinals. Do not install pex piping within a return air plenum (rated or otherwise).

3. Support pex piping at all changes in direction and at 32-inch intervals consistent with code requirements and/or local ordinanace.

L. Provide materials and installation in accordance with the local City or utility standard specifications for public works construction. Note specific requirements for sacrificial anodes, underground nuts/bolts and restraining rods, epoxy coated fittings, etc.

3.4 PIPE CONNECTIONS

A. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20. Apply appropriate tape or thread compound to external pipe threads.

B. Soldered Joints: Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPE AND HANGER SUPPORTS

A. Install pipe hangers and supports in accordance with ASME B31.9.

B. Install hangers to provide 1-inch space between finished covering and adjacent work.

C. Place hangers adjacent to fittings, within 12-inches of each horizontal elbow, and within 24-inches of connected equipment. Do not support piping from equipment.

D. Use hangers with 1-1/2-inch vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

F. Install hangers adjacent to motor driven equipment with vibration isolation.

G. Prime coat exposed steel hangers and supports.

H. Utilize floor cleats where slotted steel channels are secured to the structure.

3.6 DISINFECTION OF DOMESTIC WATER PIPING

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24-hours after flushing, from 10 percent of outlets and from water entry. Analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new water service complete with approved reduced pressure backflow preventer and water meter, pressure reducing valve, and sand strainer. Install ball type drain valve at service low point (and/or strainer blow-down).

3.8 FIELD QUALITY CONTROL

A. Testing and Inspection:

1. General: All new, altered, extended, or replaced plumbing piping systems shall be tested and inspected in accordance with the the authority having jurisdiction.

2. Tests shall be applied to systems in their entirety or in completed sections. Repair any leaks that may occur and repeat the test procedure.

3. Record and submit test and inspection reports for each system, complete with diagram or description of section tested and any corrective action taken.

4. Supply systems shall be tested under a water pressure not less than 125% of the expected working pressure of the system. The pressure shall be held for not less than 6 hours.

3.9 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe size: 1/2 inches to 1-1/4 inches:
    1) Maximum hanger spacing: 6 feet.
    2) Hanger rod diameter: 3/8 inches.
b. Pipe size: 1-1/2 inches to 2 inches:
    1) Maximum hanger spacing: 10 feet.
    2) Hanger rod diameter: 3/8 inch.
c. Pipe size: 2-1/2 inches to 3 inches:
    1) Maximum hanger spacing: 10 feet.
    2) Hanger rod diameter: 1/2 inch.
d. Pipe size: 4 inches to 6 inches:
    1) Maximum hanger spacing: 10 feet.
    2) Hanger rod diameter: 5/8 inch.

2. Plastic Piping:
    a. All Sizes:
        1) Maximum hanger spacing: 6 feet.
        2) Hanger rod diameter: 3/8 inch.
3. Pex Piping:
    a. All Sizes:
        1) Maximum hanger spacing: 32 inches.

END OF SECTION

SECTION 22 1120 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Thermal expansion tanks.

B. Hydrants and hose bibs.

C. Balancing Valves

D. Water hammer arrestors.

E. Temperature limiting valves.

F. Trap primer valves.

G. Backflow preventers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Manufacturer's standard data sheets describing components including materials, dimensions, relationship to adjacent construction, and attachments. Provide component sizes, rough-in requirements, service sizes, and finishes.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of backflow devices, water hammer arrestors, and other equipment and accessories.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALITY ASSURANCE

A. NSF Standard: Comply with NSF 372 - Drinking Water System Components - Lead Content, for materials that will be in contact with potable water.

1.7 STORAGE AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 THERMAL EXPANSION TANKS

A. Manufacturers:
   1. Amtrol Inc: amtrol.com.
   2. Taco, Inc: taco-hvac.com.
   3. Wessels Company: westank.com
   4. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII; supplied rated for a working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank and steel legs or saddles.

C. Accessories: Isolation valve, pressure gauge, air-charging fitting, tank drain with ball valve and hose thread fitting.

2.2 STRAINERS

A. Manufacturers:
   1. Watts Water Technologies.
   2. Zurn Industries.
   3. Substitutions: See Section 20 0500 for substitution procedures.

B. Size 2 inch and Under:
   1. Screwed brass or bronze body for 175 psi working pressure, wye-pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
   1. Provide flanged or grooved ductile iron body for 175 psi working pressure, wye-pattern with 1/16 inch stainless steel perforated screen.

D. Provide additional screens as may be required by the specific equipment manufacturers installation requirements.

2.3 BALANCING VALVES

A. Manufacturers:

1. IMI Hydronic Engineering (.
2. Victaulic Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Size 2 Inch and Smaller:

1. NSF approved, calibrated variable orifice, wye-pattern, globe style with threaded or soldered ends, non-ferrous DZR brass copper alloy body, EPDM O-ring seals, four-turn hand-wheel with digital readout, locking tamper-proof memory setting, and connections for portable differential meter.

2.4 HYDRANTS AND HOSE BIBS

A. Manufacturers:

1. Jay R Smith Manufacturing Company.
2. Wooford Manufacturing Company.
3. Zurn Industries.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Wall Hydrants:

1. ASSE 1019; freeze resistant, self-draining type with polished bronze wall plate, hose thread spout, removable key, and integral vacuum breaker.

C. Hose Bibs:

1. ASSE 1011; Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, with handwheel, and integral vacuum breaker.

2.5 WASHING MACHINE BOXES AND VALVES

A. Manufacturers:

1. IPS Corporation.
2. Oatay.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Valve Box: Powder-coated metal preformed rough-in box with brass valves and lever handles, socket for 3-inch waste, slip in finishing cover.

C. Dryer Box: Recessed galvanized dryer box acceptable for 2x4 nominal wall size rough-in.

2.6 REFRIGERATOR VALVE AND RECESSED BOX

A. Manufacturers:

1. IPS Corporation.
2. Oatay.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Description: Powder-coated metal preformed rough-in box with brass valves and lever handle, slip in finishing cover.

2.7 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Jay R Smith Manufacturing Company.
2. Watts Regulator Company.
3. Zurn Industries.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Water Hammer Arrestors:
1. ASSE 1010; Copper construction, lead-free, piston type sized in accordance with PDI-WH 201, pre-charged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.
2. Install in an upright position at all quick closing valves, solenoids, and plumbing fixtures. Locate and size in accordance with PDI-WH 201.

2.8 TEMPERATURE LIMITING VALVES

A. Manufacturers:
1. Powers.
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Temperature Limiting Valves:
1. ASSE 1070; constructed of solid brass, with internal components of corrosion resistant material, integral checks to prevent cross flow, and inlet screens to filter debris.
2. The valve must control each performance standard down to 0.5 gpm. Control temperature must be adjustable between 80 to 100 degrees F with a locking nut to prevent unauthorized or accidental adjustment.
3. Install at all sinks and lavatories subject to public use. Do not install at kitchen sinks or mop basins.

2.9 BACKFLOW PREVENTERS

A. Manufacturers:
1. Wilkins Valve Company.
2. Watts Regulator Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs.two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two service valves, strainer, test cocks, and supplied with an air gap fitting.
2. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves.hird check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two service valves, strainer, test cocks, and supplied with an air gap fitting.
3. Third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet.
4. Assembled with two service valves, strainer, test cocks, and supplied with an air gap fitting.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install all plumbing specialties in a readily accessible location. Install access doors where required.

C. Install approved backflow 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, hose bibbs, etc. Pipe relief to the nearest drain.

D. Install water hammer arrestors complete with accessible isolation valve on cold water supply piping to all quick closing valves, solenoids, and other locations indicated. Size and install in accordance with the mfgr's instructions.

E. Install temperature limiting valves at all single or multiple point-of-use lavatories and sinks serving public use fixtures or where required by the local authority having jurisdiction. Do not install at kitchen prep sinks.

F. Install trap primer valves with accessible isolation valves upstream and 1/2-in pex tubing downstream to a threaded connection at each floor drain or floor sink p-trap. Sleeve tubing where it will pass thru the concrete floor.

3.2 SCHEDULES

A. See equipment and accessories schedules on the drawings for Basis of Design. Other acceptable manufacturers are listed herein, provided a model of equivalent design is available.

END OF SECTION

SECTION 22 1130 - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System lubricated in-line circulators.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each product, include construction materials, rated capacities, performance curves, operating characteristics, electrical characteristics, and furnished specialties and accessories. Include certified performance curves with operating points plotted on the curves.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

B. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owners name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain pumps and accessories of each type through one source from a single manufacturer.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Comply with UL 778 for motor operated water pumps.

D. Lead Content Compliance: Comply withh NSF 61 and NSF 372.

1.7 STORAGE AND HANDLING

A. Retain manufacturers protective covers for flanges and protective coatings during storage.

B. Protect bearings and couplings against damage from sand, grit, and other foriegn matter.

C. Comply with pump manufacturer's written handling instructions.

PART 2 PRODUCTS

2.1 IN-LINE CIRCULATOR PUMPS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Grundfos: www.us.grundfos.com
2. Taco: taco-hvac.com
3. Wilo: wilo-usa.com
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Description: Factory assembled and tested, inline, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable cartridge type with motor and impeller on common shaft, designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze or stainless steel, with threaded or companion-flange connections.
3. Impellar: Plastic, composite, or stainless steel as scheduled.
4. Motor: Single, three, or variable speed as scheduled.
5. Maximum Operating Temperature: 220 degrees F.
6. Minimum Working Pressure: 125 psig.

D. Factory assembled and tested lead-free, bronze or stainless steel casing, direct connected with wet rotor motor for inline mounting, rated for 125 psig working pressure, 230 degrees F water temperature.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine rough-in for piping systems to verify actual locations of piping connections before pump installation.

B. Verify that electric power is available and of the correct characteristics.

3.2 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. Install in accordance with manufacturer's instructions.

C. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

E. Provide line sized shut-off valve on pump suction, and line sized soft seat check valve and shut-off valve on pump discharge.

F. Install flexible connectors on suction and discharge side of base pumps between pump casing and valves.

G. On pumps with integral drives, rotate the drive to be visible and accessible from the front of the pump.

H. Support with floor-mount pipe and flange supports only where mfgr suggests.

I. Lubricate pumps before start-up.

3.3 CONNECTIONS

A. Connect piping to pumps. Install suction and discharge pipe sizes equal to or greater than the diameter of pump nozzles. Decrease from line size with long radius reducing elbows or reducers. Install valves that are the same size as piping connected to the pumps.

B. Install shut-off valves and wye-type strainer and/or suction diffuser on suction side of pumps as detailed. Remove temporary strainers after system cleaning.

C. Install shut-off valve, soft seat check valve, and balancing valve, or combination pump discharge valve on discharge side of pumps as detailed.

D. Install piping, pressure gauge, and gauge cocks at tappings across suction diffuser, pump suction, and pump discharge to measure suction, discharge, and/or differential pressures from a single liquid-filled gauge.

3.4 SCHEDULES

A. See equipment schedules on the drawings for Basis of Design.

END OF SECTION

SECTION 22 1310 - DRAIN WASTE & VENT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sanitary sewer piping and fittings.

B. Storm water piping and fittings.

C. Unions, flanges, and couplings.

D. Hangers and supports.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Include data on pipe and fittings, joining materials, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1. Piping must be clearly identified with intended service and range of sizes indicated.

2. Valves and other accessories shall be identified to correspond with the piping submittals.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports: Provide evidence of piping system pressure tests. Include date, section tested, test pressure, and results.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping and valves.

1.7 QUALITY ASSURANCE

A. Identify pipe with marking including size, material classification, potable water certification, and water pressure rating.

1.8 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 delivered to the jobsite. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BELOW GRADE

A. Solid Wall PVC Pipe: ASTM D2665 or ASTM D3034, Schedule 40.

1. PVC Socket Fittings: ASTM D2665, to fit Sch 40 pipe.
2. Joints: Solvent welded, with ASTM F565 adhesive primer and ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Hubless Cast Iron Pipe: ASTM A888 or CISPI 301, service weight.

1. Fittings: Cast iron ASTM A888 or CISPI 301.
2. Joints: ASTM C1277 or CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.3 STORM WATER PIPING, BELOW GRADE

A. Solid Wall PVC Pipe: ASTM D2665, Schedule 40.

1. PVC Socket Fittings: ASTM D2665, to fit Sch 40 pipe.
2. Joints: Solvent welded, with ASTM F565 adhesive primer and ASTM D2564 solvent cement.

2.4 STORM WATER PIPING, ABOVE GRADE

A. Hubless Cast Iron Pipe: ASTM A888 or CISPI 301, service weight.

1. Fittings: Cast iron ASTM A888 or CISPI 301.
2. Couplings: ASTM C1277 or CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.5 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Hangers for Pipe Sizes 1/2 to 2-inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2-1/2 to 6-inch: Carbon steel, adjustable, clevis.

D. Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Supports: Slotted channel framing with insulated strut clamps.

F. Vertical Supports: Steel riser clamps.

G. Hanger Rods: Mild steel continuous threaded.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine piping interior for cleanliness, freedom from foreign matter, and corrosion.

B. Remove scale and dirt on inside and outside before assembly.

C. Protect open ends of pipe with temporary plugs or caps during construction.

D. Do not install below grade piping when bedding is wet or frozen.

3.2 GENERAL PIPING 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. Drawing plans indicate general location and arrangement of piping systems. Install piping as closely as possible to that indicated unless deviations to layout are approved.

C. Route piping in an orderly manner, parallel and perpendicular to building structure.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install firestopping to preserve fire resistance rating of partitions and other elements.

G. Install piping free of sags and bends. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Sleeve all piping passing through partitions, walls, and floors. Install escutcheons on exposed, finished side of penetrations.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Provide galvanized hangers and supports and accessories in locations exterior to the building.

L. Provide access doors where valves and fittings are not exposed or otherwise inaccessible.

M. Install piping to permit valve servicing. Install valves with stems upright or horizontal, not inverted.

N. Where buried non-metallic piping is used, install 10-gauge solid copper tracer wire suitable for direct bury with the piping.

O. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

3.3 DWV PIPING INSTALLATION

A. Establish elevations of buried piping outside the building to ensure not less than the indicated depth of cover.

B. Install piping penetrating roofed areas to maintain integrity of roof assembly.

C. Install bell and spigot pipe with bell end upstream.

D. Install permanent labels designating "overflow" at all appropriate discharge spout locations.

E. Where modifications to layouts are proposed, include wall cleanouts after every 135-degrees of turn. Floor cleanouts will be considered as a last resort only.

F. Provide materials and installation in accordance with the local City or utility standard specifications for public works construction. Note specific requirements for underground nuts/bolts and restraining rods, epoxy coated fittings, etc.

3.4 CONNECTIONS

A. Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to ASTM D2855 and ASTM D2665 appendixes.

B. Hubless Joints: Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20. Apply appropriate tape or thread compound to external pipe threads.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with ASME B31.9.

B. Install hangers to provide 1-inch space between finished covering and adjacent work.

C. Place hangers adjacent to fittings, within 12-inches of each horizontal elbow, and within 24-inches of connected equipment. Do not support piping from equipment.

D. Use hangers with 1-1/2-inch vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

F. Install hangers adjacent to motor driven equipment with vibration isolation.

G. Prime coat exposed steel hangers and supports.

3.6 APPLICATION

A. Provide brass or copper nipples at trap arms and dirty arms. Galvanized piping is not permitted.

B. Exposed accessories beneath sinks and lavatories shall include chrome plated brass p-traps and extensions, quarter-turn angle stops, and braided stainless steel flexible supplies.

3.7 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2-inch vertically of locations indicated. Unless noted otherwise, slope to drain as follows:

1. Pipe size 4-inch and smaller: Slope at a minimum of 1/4-inch per foot.
2. Pipe size 5-inch and larger: Slope at a minimum of 1/8-inch per foot.

3.8 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspection:

1. General: All new, altered, extended, or replaced plumbing piping systems shall be tested and inspected in accordance with the the authority having jurisdiction.
2. Tests shall be applied to systems in their entirety or in completed sections. Repair any leaks that may occur and repeat the test procedure.
3. Record and submit test and inspection reports for each system, complete with diagram or description of section tested and any corrective action taken.
4. Sanitary and storm systems shall be filled with water and tested with no less than a 10 foot head of water. The pressure shall be held for not less than 15 minutes.

3.10 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:
    a. Pipe size: 1/2 inches to 1-1/4 inches:
        1) Maximum hanger spacing: 6 feet.
        2) Hanger rod diameter: 3/8 inches.
    b. Pipe size: 1-1/2 inches to 2 inches:
        1) Maximum hanger spacing: 10 feet.
        2) Hanger rod diameter: 3/8 inch.

c. Pipe size: 2-1/2 inches to 3 inches:
    1) Maximum hanger spacing: 10 feet.
    2) Hanger rod diameter: 1/2 inch.
d. Pipe size: 4 inches to 6 inches:
    1) Maximum hanger spacing: 10 feet.
    2) Hanger rod diameter: 5/8 inch.

2. Plastic Piping:
    a. All Sizes:
        1) Maximum hanger spacing: 6 feet.
        2) Hanger rod diameter: 3/8 inch.

END OF SECTION

SECTION 22 1320 - DRAIN WASTE & VENT PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof and floor drains.

B. Wall and floor cleanouts.

C. Trap primers and seals.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Manufacturer's standard data sheets describing components including materials, dimensions, relationship to adjacent construction, and attachments. Provide component sizes, rough-in requirements, service sizes, and finishes.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of cleanouts, trap primers, and other equipment and accessories.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 STORAGE AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. See equipment and accessories schedules on the drawings for Basis of Design. Other acceptable manufacturers are listed herein, provided a model of equivalent design is available.

2.2 ROOF AND FLOOR DRAINS

A. Manufacturers:

1. Jay R Smith Manufacturing Company.
2. Josam Company.
3. Zurn Industries.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. General:

1. Precise locations of drains shall be detailed by the architectural drawings. Where drain locations conflict with structural elements, confirm locations with architect prior to rough-in.
2. Furnish flashing flange for all structural type membrane floors.

C. Floor Drain:

1. ASME A112.6.3; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

D. Floor Sink:

1. ASME A112.6.3; 12 inch square cast iron flanged receptor with seepage holes, acid resistant coated interior, and loose set acid resistant coated cast iron grate, body with dome strainer. Provide 6 inch depth unless noted otherwise.

E. Roof Drain:

1. ASME A112.6.4; lacquered cast iron body with adjustable extension sleeve, reversible collar, combined flashing clamp and gravel stop, sump receiver, underdeck clamp, and cast iron dome.

F. Overflow Drain:

1. ASME A112.6.4; lacquered cast iron body with adjustable extension sleeve, reversible collar, combined flashing clamp and 2 inch high water dam, sump receiver, underdeck clamp, and cast iron dome.

G. Downspout Nozzle:

1. Cast bronze body and flange.

2.3 WALL AND FLOOR CLEANOUTS

A. Manufacturers:

1. Jay R Smith Manufacturing Company.
2. Josam Company.
3. Zurn Industries:.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. General:

1. Furnish and install cleanouts where indicated on the drawings and at all bends, angles, upper terminals, and not over 50 feet apart.
2. All cleanouts to have bronze countersunk rectangular slotted plugs lubricated with non-hardening thread lubricant.
3. Flush-with-floor cleanout tops shall have non-skid covers.
4. Furnish flashing flange for all structural type membrane floors.

C. Interior Finished Floors:

1. Cast iron adjustable floor level cleanout assembly with round nickel bronze top.

D. Exterior Unfinished Floors:

1. Cast iron adjustable floor level cleanout assembly with round heavy duty cast iron top.

E. Interior Finished Walls:

1. Cast iron ferrule with lead seal plug, round stainless steel cover with center screw.

2.4 TRAP SEALS

A. Manufacturers:

1. ProVent Systems.
2. Jay R Smith Manufacturing Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Trap Seals:

1. ASSE 1072; elastomeric, normally closed, floor drain evaporation resistant sealing system.
2. Trap seals may be installed in lieu of trap primers with approval of the authority having jurisdiction.
3. Trap seals may not be used in kitchens or other areas subject to wax or grease.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install all plumbing specialties in a readily accessible location. Install access doors where required.

C. Floor drains and floor sinks are shown approximate. Confirm all locations with furnishings of other trades prior to rough-in, and set final elevation to accommodate sloping floors.

D. Coordinate drain locations with areas and fixtures served. Do no locate under sink, table, or partition legs. Strainers shall be easily accessible for removal and cleaning.

E. Extend cleanouts to finished floor or wall surface. Ensure clearance at cleanout for rodding of drainage system. Encase exterior cleanouts in concrete flush with grade. Size to be 24-in by 24-in by 6-in thick minimum.

F. Protect drains and other specialties during construction to avoid clogging with dirt or debris, and to prevent damage from traffic or other construction work. Plug all open ends of incomplete piping at the end of each day's work.

G. In lieu of trap primer valves and with permission of the authority having jurisdiction, install listed and approved trap primer seals at each floor drain and floor sink. Do not install in kitchens or where waxed floor surfaces will be installed.

H. Where not indicated by architectural drawings:

1. Set floor drains for individual restrooms, custodial closets, and other small areas depressed into slabs 1/4-inch.
2. Set floor drains for gang restrooms and other larger areas depressed into slabs 1/2-inch.
3. Set floor sinks such that the grate is flush with the floor level and accessible.
4. Install drains with the slab installation.

END OF SECTION

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric domestic water heaters.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

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

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include wiring diagrams for power, signal, and control wiring.
4. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps and accessories of each type through one source from a single manufacturer.

B. NSF Compliance: Comply with NSF/ANSI 61 and NSF/ANSI 372 for lead-free plumbing reuirements.

C. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. UL Compliance: Comply with UL 778 for motor operated water pumps.

E. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

1.7 STORAGE AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 ELECTRIC DOMESTIC WATER HEATERS

A. Manufacturers:

1. AO Smith Water Products Co: hotwater.com.
2. Bradford White Corp: bradfordwhite.com.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Tank: ASME glass-lined welded steel tank, 150-psig working pressure, thermally insulated with minimum 2-inches of glass fiber, and encased in a corrosion-resistant steel jacket with a baked enamel finish.

C. Elements: Dual or triple element, simultaneous or non-simultaneous, screw-in or bolt-on immersion type. Control shall include a thermostat with each element and a high temperature limit cutoff.

D. Accessories: Dip tube, anode rod, temperature and pressure relief valve, tank drain with cap, water inlet and outlet unions and isolation valves, outlet thermometer with range of 40 to 160F.

2.2 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring. Electrical characteristics to be as specified or indicated.

B. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

C. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certifications.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Arrange units so controls and devices that require servicing are accessible.

D. Install combination temperature and pressure relief valves in top portion of storage tanks or in water piping for water heaters without storage. Discharge by air gap into nearest floor drain.

E. Install water heater drain piping as indirect waste to spill by air gap into open drains. Install hose-end drain valves at low points in water piping for heaters that do not have tank drains.

F. Install thermometers on outlet piping on domestic water heaters.

G. Install dielectric fittings in locations where piping of dissimilar metals to be joined.

H. Install condensate collectors and pipe to the nearest floor drain.

3.2 TESTING

A. Perform each visual and mechanical inspection required by the manufacturer.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.3 SCHEDULES

A. See equipment schedules on the drawings for Basis of Design.

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Mop basins.

F. Water coolers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of product:

1. Include selected fixture and trim, fittings, accessories, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

    a. Each fixture and all related accessory trim shall be submitted grouped together and clearly identified to correspond with the individually scheduled mark.

    b. Submittals with cut sheets referencing multiple fixtures and/or not grouped according to the scheduled mark will be returned without review.

    c. Color to be manufacturer's standard commercial bright white unless noted otherwise.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fixtures, faucets, flush valves, and electronic sensors to include in operation and maintenance manuals. Include fixture trim exploded view and replacement parts lists.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each source through one source from a single manufacturer, unless specifically indicated otherwise.

B. Products Requiring Electrical Connection: Listed and labeled as defined in NFPA 70, by Underwriters Laboratories, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ANSI A117 and Americans with Disabilities Act regarding plumbing fixture for people with disabilities.

D. NSF Standard: Comply with NSF 372 - Drinking Water System Components - Lead Content, for faucet materials that will be in contact with potable water.

1.7 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.

C. All fixtures shall be protected from damage to the date of final acceptance ot the project. Any fixture or component found defective or damaged shall be replaced, not repaired.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All plumbing fixtures and trim shall be of one make, except where noted otherwise. All trim shall consist of chrome-plated brass, including faucet spouts and handles unless otherwise specified.

B. All plumbing fixtures shall be set level and plumb, spaced in accordance with the architectural drawings, and securely installed so as to be absolutely rigid. Provide sealant at all mounting surfaces.

C. All hot and cold water connections shall be provided with chrome plated annealed supplies and angle stops. All wall penetrations shall be finished with chrome-plated escutcheons for complete coverage.

D. All wall mounted fixtures shall be installed with floor mounted, concealed arm type carrier supports, for the wall depths shown on the architectural drawings.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

B. Vitreous China Fixtures:

1. American Standard.
2. Kohler Company.

C. Flush Valves:

1. Sloan Valve Company.

D. Stainless Steel Fixtures:

1. Elkay Manufacturing Company.
2. Just Manufacturing.

E. Lavatory and Sink Faucets:

1. Delta Faucet Company.

F. Water Coolers:

1. Elkay Manufacturing Company.

G. Mop Service Basins:

1. Fiat Products: www.fiatproducts.com.

H. Substitutions: See Section 20 0500 for substitution procedures.

2.3 WATER CLOSETS

A. Water Closets: ASME A112.19.2; vitreous china, floor-mounted gravity tank with elongated rim.

1. Bowl Type: Siphon jet action.
2. Flush Volume: Low consumption.
3. Outlet Size: 3-inch.

B. Seats: Solid plastic, elongated rim, open front, extended back, self-sustaining hinge, brass bolts, without cover, white in color.

C. Accessories:

1. Right or left-hand actuator to satisfy ADA requirements.
2. Screwdriver or loose-key quarter-turn stops.
3. Chrome-plated rigid or flexible supplies with escutcheons.

D. Supply Fittings: Chrome-plated brass, quarter-turn, ball-type or compression stop with inlet connection matching water supply piping type and size. Chrome-plated brass or copper tubing. Chrome-plated brass wall flange.

2.4 WATER CLOSETS

A. Water Closets: ASME A112.19.2; vitreous china, floor-mounted or wall-hung with elongated rim.

1. Flush Volume: 1.6 gallon, maximum.
2. Flush Style: Siphon jet flush action.
3. Flush Valve: Exposed (top spud).
4. Flush Operation: Sensor operated.
5. Supply Size: 1-inch.
6. Outlet Size: 3-inch.

B. Flush Valves: ASSE 1037, diaphragm type, with integral check stops and backflow device.

1. Sensor Type: Solenoid operator, battery powered, infrared sensor and over-ride push button.
2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

C. Seats: Solid plastic, elongated rim, open front, extended back, self-sustaining hinge, brass bolts, without cover, white in color.

D. Carriers: ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Do not use back-to-back carriers unless indicated otherwise.

2.5 URINALS

A. Urinals: ASME A112.19.2; vitreous china, wall hung with side shields and integral trap.

1. Flush Volume: 1.0 gallon, maximum.
2. Flush Style: Washout flush action.
3. Flush Valve: Exposed (top spud).
4. Flush Operation: Sensor operated.
5. Supply Size: 3/4-inch.
6. Outlet Size: 2-inch.

B. Flush Valves: ASSE 1037, diaphragm type, with integral check stops and backflow device.

1. Sensor Type: Solenoid operator, battery powered, infrared sensor and over-ride push button.
2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

C. Carriers: ASME A112.6.1M; Type I urinal carrier, cast iron and steel frame, with fixture support plates and coupling with seal for wall-mounting urinal-type fixture. Include steel uprights with feet.

2.6 LAVATORIES

A. Wall-Mounted: ASME A112.19.2; vitreous china, rectangular basin with splash lip, ledge back, front overflow, and soap depression.

B. Counter-Mounted: ASME A112.19.2; vitreous china, self-rimming, oval or round basin with front overflow and soap depressions.

C. Undercounter-Mounted: ASME A112.19.2; vitreous china, oval or round basin with front overflow and soap depression.

D. Supply Faucet: ASME A112.18.1; brass body, chrome plated supply fitting with indexed handles, open grid strainer, and water economy aerator with maximum flow of 2.2-gal per minute.

E. Accessories:

1. Chrome-plated 17-gauge brass p-trap and arm with escutcheon.
2. Offset waste with perforated open strainer.
3. Screwdriver or loose-key quarter-turn stops.
4. ASSE 1070 solid brass temperature limiting valves.
5. Chrome-plated rigid or flexible supplies with escutcheons.
6. ADA compliant protective pipe covers where indicated.

F. Carriers: ASME A112.6.1M; type II lavatory carrier, cast iron and steel frame, with concealed arms and tie rod for wall-mounting lavatory-type fixture. Include rectangular steel uprights for accessible fixtures.

2.7 SINKS

A. Counter-Mounted: ASME A112.19.3; 18-gauge, Type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.

B. Supply Faucet: ASME A112.18.1; brass body, chrome plated supply fitting with indexed handles, open grid strainer, and water economy aerator with maximum flow of 2.2-gal per minute.

C. Food Waste Disposer: Where indicated on the drawings, include a food waste disposal with two-stage grind, anti-vibration mount, stainless steel chamber, and minimum 6-year manufacturers warranty.

D. Accessories:

1. Chrome plated 17-gauge brass p-trap and arm with escutcheon.
2. Basket strainer or offset waste with perforated open strainer.
3. Screwdriver or loose-key quarter-turn stops.
4. ASSE 1070 solid brass temperature limiting valves.
5. Chrome-plated rigid or flexible supplies with escutcheons.
6. ADA compliant protective pipe covers where indicated.

2.8 MOP SERVICE BASINS

A. Mop Basin: White molded stone, floor mounted, with one inch wide shoulders, stainless steel strainer.

B. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver check stops with covering caps and adjustable threaded wall flanges.

C. Accessories:

1. Plain end reinforced plastic hose, 1/2-inch diameter, 5-ft length.
2. Hose clamp hanger.
3. Mop hanger.

2.9 DRINKING FOUNTAINS

A. Water Cooler: Electric, mechanically refrigerated; surface handicapped mounted; stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push bar controls, touchless bottle filling station, with integral air cooled condenser and stainless steel grille.

1. Capacity: 8-gal per minute of 50-deg F water with inlet at 80-deg F and room temperature of 90-deg F, when tested in accordance with ASHRAE Std 18.
2. Electrical: 115 V, 60 Hertz compressor, 6-foot cord and plug for connection to electric wiring system including grounding connector.
3. Bottle Filling Station: Sanitary, touchless activation with auto 20-sec shut-off timer, 1.1-gal per minute laminar flow, where indicated.

2.10 PROTECTIVE PIPE COVERS

A. Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies and trap and drain piping. Comply with ADA requirements.

1. Single or multi-piece design, non-absorbent, uv-inhibited, anti-microbial surface with white finish and tamper-resistant fastening system.
2. Tested in compliance with ASTM E84, with a 25 flame spread index and 450 smoke developed index.

2.11 FITTINGS FOR PLUMBING FIXTURES

A. Refer to plumbing fixtures schedules on the drawings for specific accessories and fittings. Other miscellaneous fittings include:

1. Supply Stops: Chrome-plated brass, angle or straight, quarter-turn ball-type or compression valve, same size as indicated supply.
2. Supply Piping: Chrome-plated-brass pipe, or chrome-plated copper tube, or braided stainless steel flexible connectors matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

3. Traps: Tubular brass with 17-gauge wall thickness, slip-joint inlet, wall-flange, escutcheons, and size as indicated on the drawings. Use chrome-plated tube for exposed applications.
4. Continuous Waste: Tubular brass, minimum 17-gauge wall thickness, with slip joint inlet. Use chrome-plated tube for exposed applications. Size to match equipment.
5. Indirect Waste: PVC or copper, size to match fixture.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and casework for suitable conditions where fixtures are to be installed.

B. Examine rough-in for sanitary drainage and vent piping systems and supports to verify actual sizes and locations and types of supports, before fixture installation.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks before rough-in and installation.

D. Where applicable, verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated on the drawings.

3.3 INSTALLATION

A. Install fixtures level and plumb. Assemble fixtures, trim, fittings, and other components according to manufacturer's written instructions and rough-in drawings.

B. Install accessible, wall-mounted fixtures at mounting height for handicapped/elderly in accordance with ANSI A117.1.

C. Install lever-operated water closets and flush valves for accessible water closets with handle mounted on open side of water closet.

D. Attach supply piping to supports or substrate within pipe spaces behind fixtures so as to be rigid and not subject to push or pull movement.

E. Install supports, affixed to building substrate, for wall-mounted fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

F. Install counter mounted fixtures in and attached to casework.

G. Install control modules for infrared faucets high up under the fixture to hide all wiring.

H. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.

I. Install trap and waste piping on drain outlet of fixtures that are indicated to be directly connected to drainage system.

J. Install indirect waste piping on drain outlet of fixtures that are indicated to be indirectly connected to drainage system.

K. Install escutcheons at piping penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern if required to conceal protruding fittings.

L. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

M. Install temperature limiting devices on all public fixtures. Mount high up out of view between the rough-in and the fixture.

N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.

O. Install waste disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

P. Double-nut fixture studs at the face plates on all wall-mounted water closet carrier supports.

3.4 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings and controls.

B. Adjust temperature limiting devices to the Owner's preference. Adjust any rotational limit stops on shower valves to a safe temperature.

C. Operate and adjust disposers and controls. Replace damaged and malfunctioning units.

D. Adjust water pressure for intended water flow rate to fixtures without splashing, noise, or overflow.

E. Replace washers and seals of leaking and dripping faucets and stops.

F. Install new batteries in sensor-operated equipment at the time of close-out.

3.5 CLEANING

A. Clean fixtures, faucets, and fittings with manufacturer's recommended cleaning methods and materials.

B. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.

C. Remove sediment and debris from traps and drains.

3.6 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by the Owner.

C. Repair or replace damaged products prior to the date of substantial completion.

3.7 SCHEDULES

A. Fixtures and Faucets: See fixture schedules on the drawings for Basis of Design.

B. Fixture Heights: Install fixtures to heights above finished floor as indicated on the architectural drawings.

END OF SECTION

DIVISION

23

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 1110 - FUEL GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Natural gas piping and fittings.

B. Unions, flanges, and couplings.

C. Hangers and supports.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Include data on pipe and fittings, joining materials, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1. Piping must be clearly identified with intended service and range of sizes indicated.

2. Valves and other accessories shall be identified to correspond with the piping submittals.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports: Provide evidence of piping system pressure tests. Include date, section tested, test pressure, and results.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping and valves.

1.7 QUALITY ASSURANCE

A. Welder Qualifications: Certified in accordance with ASME BPVC Section IX. Maintain current certifications.

B. Welding Materials and Procedures: Comply with ASME BPVC Section IX and applicable state labor regulations.

C. Identify pipe with markings, including size, material classification, and ASME Specification.

1.8 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 delivered to the jobsite. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, wrought steel welding type.
2. Joints: NFPA 54, threaded or welded to ASME B31.1.

2.2 NATURAL GAS PIPING, BELOW GRADE

A. Polyethylene Pipe: ASTM D2513, SDR 11.

1. PE Fittings: ASTM D2683 or ASTM D2513 socket fusion type.
2. Joints: Fusion welded.

2.3 UNIONS FLANGES AND COUPLINGS

A. Unions for Pipe Sizes 2 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 2-1/2 Inches and Over:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Hangers for Pipe Sizes 1/2 to 2-inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2-1/2 to 6-inch: Carbon steel, adjustable, clevis.

D. Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Supports: Slotted channel framing with insulated strut clamps.

F. Vertical Supports: Steel riser clamps.

G. Hanger Rods: Mild steel continuous threaded.

2.5 WARNING TAPE

A. Acid and alkali resistant polyethylene warning tape for marking and identifying underground utilities, 6-inches wide and 4-mils thick, continuously inscribed with description and pressure.

B. Metallic core encased in protective jacket, detectable by metal detector at depths up to 30-inches, yellow in color.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine piping interior for cleanliness, freedom from foreign matter, and corrosion.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Protect open ends of pipe with temporary plugs or caps.

E. Do not install below grade piping when bedding is wet or frozen.

3.2 GENERAL PIPING 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. Drawing plans indicate general location and arrangement of piping systems. Install piping as closely as possible to that indicated unless deviations to layout are approved.

C. Route piping in an orderly manner, parallel and perpendicular to building structure.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install firestopping to preserve fire resistance rating of partitions and other elements.

G. Install piping free of sags and bends. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Sleeve all piping passing through partitions, walls, and floors. Install escutcheons on exposed, finished side of penetrations.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Provide galvanized hangers and supports and accessories in locations exterior to the building.

L. Provide access doors where valves and fittings are not exposed or otherwise inaccessible.

M. Install piping to permit valve servicing. Install valves with stems upright or horizontal, not inverted.

N. Where buried non-metallic piping is used, install 10-gauge solid copper tracer wire suitable for direct bury with the piping.

O. Install piping adjacent to equipment to allow service and maintenance access. Install unions and shut-off valves at all equipment inlets and outlets.

P. Wall mounted piping is permitted only where indicated, and shall be secured to 12-gauge 1-5/8 inch slotted channel framing with insulated strut clamps.

Q. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

3.3 GAS PIPING INSTALLATION

A. Install gas fuel piping to ASME B31.9

B. Comply with NFPA 54 for installation and purging of natural-gas piping.

C. Install piping in accordance with all appliance or equipment manufacturer instructions.

D. Install piping penetrating roofed areas to matina integrity of the roof assembly.

E. Provide support for utility meters in accordance with requirements of utility companies.

F. Connect branch piping from the top or side of horizontal piping.

G. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down. Connect branch piping from the top or side of horizontal piping.

H. Install underground natural-gas piping buried at least 36-inches below finished grade. If installed less than 36-inches, install within a containment conduit.

I. Install underground polyethylene natural-gas piping according to ASTM D2774. Install free of splices or joints unless otherwise approved in writing.

J. Install factory fabricated and leak tested anodeless service line risers at all locations where natural-gas piping transitions from above and below ground installation.

K. Where equipment regulators are indicated, size the regulator and the downstream piping in accordance with the manufacturer's instructions or applicable current regulations.

L. Install drips and sediment traps at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying.

   1. Construct drips using tee fitting with bottom outlet plugged or capped.

   2. Use nipples same size as connected pipe, not less than 3-inches long.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap and screen.

N. Install unions in pipes 2-inches and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

O. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valves. Install pressure gauge downstream from each line regulator.

P. Install all pipe-mounted devices. See specifications of other trades for other requirements.

Q. Provide materials and installation in accordance with the local City or utility standard specifications for public works construction.

3.4 CONNECTIONS

A. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20. Apply appropriate tape or thread compound to external pipe threads.

B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

C. Where indicated, provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure as indicated on the drawings.

3.5 PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with ASME B31.9.

B. Install hangers to provide 1-inch space between finished covering and adjacent work.

C. Place hangers adjacent to fittings, within 12-inches of each horizontal elbow, and within 24-inches of connected equipment. Do not support piping from equipment.

D. Use hangers with 1-1/2-inch vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

F. Support piping on flat roofs with UV stable blocks including integral steel strut channel.

G. Install hangers adjacent to motor driven equipment with vibration isolation.

H. Prime coat exposed steel hangers and supports.

I. Utilize floor cleats where slotted steel channels are secured to the structure.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspection:

1. General: All new, altered, extended, or replaced plumbing piping systems shall be tested and inspected in accordance with the following requirements and the authority having jurisdiction.

2. Tests shall be applied to systems in their entirety or in completed sections. Repair any leaks that may occur and repeat the test procedure.

3. Record and submit test and inspection reports for each system, complete with diagram or description of section tested and any corrective action taken.

4. Gas Piping: Gas piping systems shall be installed, examined, inspected, and tested in accordance with requirements of the International Fuel Gas Code and the authority having jurisdiction.

3.7 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:
    a. Pipe size: 1/2 inches to 1-1/4 inches:
        1) Maximum hanger spacing: 6 feet.
        2) Hanger rod diameter: 3/8 inches.
    b. Pipe size: 1-1/2 inches to 2 inches:
        1) Maximum hanger spacing: 10 feet.
        2) Hanger rod diameter: 3/8 inch.
    c. Pipe size: 2-1/2 inches to 3 inches:
        1) Maximum hanger spacing: 10 feet.
        2) Hanger rod diameter: 1/2 inch.
    d. Pipe size: 4 inches to 6 inches:
        1) Maximum hanger spacing: 10 feet.
        2) Hanger rod diameter: 5/8 inch.
2. Plastic Piping:
    a. All Sizes:
        1) Maximum hanger spacing: 6 feet.
        2) Hanger rod diameter: 3/8 inch.

END OF SECTION

SECTION 23 1120 - FUEL GAS PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gas valves.

B. Gas pressure regulators.

C. Gas service risers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Manufacturer's standard data sheets describing components including materials, dimensions, relationship to adjacent construction, and attachments. Provide component sizes, rough-in requirements, service sizes, and finishes.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of fuel gas valves, devices, and other equipment and accessories.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALITY ASSURANCE

A. NSF Standard: Comply with NFPA 54 - National Fuel Gas Code for materials and installation practices.

1.7 STORAGE AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GAS VALVES

A. Ball Valves for Pipe Sizes 4-Inches and Under:

1. Two-piece, full-port, bronze ball valve with bronze trim, MSS SP-110.
2. Chrome plated bronze ball, bronze blowout proof stem with reinforced teflon seats.
3. Threaded or flanged ends, 600 psi, stamped WOG, suitable for natural gas service.

B. Plug Valves for Pipe Sizes 4-Inches and Under:

1. Bronze body complying with ASTM B584, bronze plug, MSS SP-78.
2. Cast iron body complying with ASTM A126, bronze or nickel plated plug, MSS SP-78.
3. Square head or lug type operator with tamperproof locking feature.
4. Threaded or flanged ends, 125 psi, stamped WOG, suitable for natural gas service.

C. Manufacturers:

1. Conbraco Industries: apollovalves.com
2. AY McDonald Manufacturing: aymcdonald.com
3. Mueller Streamline Company: muellerindustries.com
4. Substitutions: See Section 20 0050 for substitution procedures.

2.2 GAS PRESSURE REGULATORS

A. ANSI Z21.80 approved, spring-loaded double diaphragm type with corrosion resistant aluminum alloy construction, capable of precise regulating control from full flow down to pilot flow.

B. Step-down reducing pressure regulators shall deliver positive dead-end lock-up, with vent limiting devices for indoor applications and vent protectors for outdoor installations, where permitted by the authority having jurisdiction.

C. Provide over-pressure devices for step-down regulators with upstream pressures greater than 2-psig. Install with test tees in accordance with the current code.

D. Manufacturers:

1. Maxitrol Company: maxitrol.com
2. Fisher Controls International: fisherregulators.com
3. Substitutions: See Section 20 0050 for substitution procedures.

2.3 GAS SERVICE LINE RISERS

A. Factory fabricated and leak-tested, anodeless service line riser consisting of an underground PE pipe complying with ASTM D2513, SDR 11 inlet connected to a steel pipe complying with ASTM A53, Schedule 40 black steel, Type E, S, or B, with corrosion protective covering.

1. Outlet shall be threaded or flanged or suitable for welded connection.
2. Bridging sleeve over mechanical coupling.
3. Factory connected anode.
4. Tracer wire connection.
5. Ultraviolet shield.
6. Stake supports with factory finish to match steel pipe casing or carrier pipe.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install all specialties in a readily accessible location. Install access doors where required.

C. See fuel gas piping specifications for additional installation requirements.

END OF SECTION

SECTION 23 2110 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heating water piping and fittings.

B. Chilled water piping and fittings.

C. Unions, flanges, and couplings.

D. Hangers and supports.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Include data on pipe and fittings, joining materials, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1. Piping must be clearly identified with intended service and range of sizes indicated.
2. Valves and other accessories shall be identified to correspond with the piping submittals.
3. Show grooved joint couplings, fittings, valves, and specialties, identified with the manufacturer's style or series designation.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports: Provide evidence of piping system pressure tests. Include date, section tested, test pressure, and results.

B. Welders Certificate: Include welders certification of compliance with referenced standards.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping and valves.

1.7 QUALITY ASSURANCE

A. Source Limitations: Provide all grooved joint couplings, fittings, specialties, and grooving tools from a single manufacturer.

B. Welder Qualifications: Certify in accordance with ASME BPVC Section IX. Maintain current certifications.

C. Welding Materials and Procedures: Comply with ASME BPVC Section IX and applicable state labor regulations.

D. Identify pipe with markings, including size, material classification, and ASME Specification.

1.8 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 delivered to the jobsite. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 HEATING AND CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53, Schedule 40, black.

1. Welded Joints: ASTM A234, wrought steel welding type fittings; AWS D1.1 welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88, Type M.

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    b. Brazed: AWS A5.8 BCuP copper/silver alloy.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, non toxic synthetic rubber sealing elements.

2.2 EQUIPMENT DRAINS

A. Copper Tube: ASTM B88, Type M.

1. Fittings: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper.
2. Solder Joints: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: Solvent welded in accordance with ASTM D2855.

2.3 UNIONS FLANGES AND COUPLINGS

A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150-psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150-psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16-inch thick preformed neoprene.

C. Mechanical Couplings: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket. Rigid type only, except where flexible couplings are specifically indicated for expnsion..

1. Dimensions and Testing: In accordance with AWWA C606.
2. Mechanical Couplings: Comply with ASTM F1476.
3. Housing Material: Ductile iron complying with ASTM A536.
4. Gasket Material: EPDM suitable for operating temperature range from -30F to 230F.
5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:

1. Waterways:
    a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    b. Dry insulation barrier able to withstand 600-volt breakdown test.
    c. Galvanized steel with threaded end connections to match connecting piping.
    d. Suitable for the required operating pressures and temperatures.
2. Flanges:
    a. Dielectric flanges with same pressure ratings as standard flanges.
    b. Water impervious insulation barrier capable of limiting galvanic current to 1-percent of short circuit current in a corresponding bimetallic joint.
    c. Dry insulation barrier able to withstand 600-volt breakdown test.
    d. Galvanized steel with threaded end connections to match connecting piping.
    e. Suitable for the required operating pressures and temperatures.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Hangers for Pipe Sizes 1/2 to 2-inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2-1/2 to 6-inch: Carbon steel, adjustable, clevis.

D. Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Supports: Slotted channel framing with insulated strut clamps.

F. Vertical Supports: Steel riser clamps.

G. Hanger Rods: Mild steel continuous threaded.

2.5 DRAIN VALVES

A. Drain valves shall be ball valves as specified herein or ball valves as part of an integral flange isolator product.

B. All drain valves shall be fitted with standard hose thread fittings and blind hose caps.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine piping interior for cleanliness, freedom from foreign matter, and corrosion.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

E. Protect open ends of pipe with temporary plugs or caps.

F. Do not install below grade piping when bedding is wet or frozen.

3.2 GENERAL PIPING 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. Drawing plans indicate general location and arrangement of piping systems. Install piping as closely as possible to that indicated unless deviations to layout are approved.

C. Route piping in an orderly manner, parallel and perpendicular to building structure.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install firestopping to preserve fire resistance rating of partitions and other elements.

G. Install piping free of sags and bends. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Sleeve all piping passing through partitions, walls, and floors. Install escutcheons on exposed, finished side of penetrations.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Provide galvanized hangers and supports and accessories in locations exterior to the building.

L. Provide access doors where valves and fittings are not exposed or otherwise inaccessible.

M. Install piping to permit valve servicing. Install valves with stems upright or horizontal, not inverted.

N. Install piping adjacent to equipment to allow service and maintenance access. Install unions and shut-off valves at all equipment inlets and outlets. Provide appropriate equipment grounding.

O. Wall mounted piping is permitted only where indicated, and shall be secured to 12-gauge 1-5/8 inch slotted channel framing with insulated strut clamps.

P. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

3.3 HYDRONIC PIPING INSTALLATION

A. Install hydronic water piping to ASME B31.9 requirements.

B. Make piping connections between dissimilar metal piping with non-conducting dielectric fittings or waterways.

C. Grooved mechanical joints may be used in accessible locations only. Accessible locations include mechanical spaces, pipe chases, above ground outdoors, and where specifically approved.

D. Install grooved joints in accordance with the manufacturer's installation instructions. Grooved joint gaskets to be suitable for the intended service.

E. Provide air vents at all equipment and coils, at all high points in systems, at the top of all risers, and at down fed elbows so any given section may have air removed.

F. Install unions in piping 2-inches and smaller, adjacent to valves, at final connections to equipment, and elsewhere as indicated. Install flanges in piping 2-1/2-inches and larger.

G. Install pipe loops, piping offsets and/or swing joints allowing free movement of piping to control expansion and contraction.

H. Install all automatic control valves, and other pipe-mounted devices. See specifications of other trades for other requirements.

I. Install drain valves at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use ball valves with hose end and drain cap.

J. Take-offs to equipment shall be made with connections above or below the mains at an angle of 45-degrees from level.

K. Piping take-offs to terminal equipment shall be from the branch tee connection only. Do not use run ends of reducing tees.

L. Do not install pipe tees in the bullhead position (supply or return). Do not install pipe tees where flow thru the branch is greater than one of the runs.

M. Install temporary bypass piping around all equipment not designed for cleaning and flushing.

N. Grooved mechanical joints may be used in accessible locations only. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, above ground outdoors, and as approved by Engineer.

3.4 CONNECTIONS

A. Connections: Provide pipe-to-valve and pipe-to-equipment connections as follows:

1. Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

2. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Apply appropriate tape or thread compound to external pipe threads.

C. Soldered Joints: Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPE HANGERS AND SUPPORTS

A. Install pipe hangers and supports in accordance with ASME B31.9.

B. Install hangers to provide 1-inch space between finished covering and adjacent work.

C. Place hangers adjacent to fittings, within 12-inches of each horizontal elbow, and withiin 24-inches of connected equipment. Do not support piping from coils or other equipment.

D. Use hangers with 1-1/2-inch vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

F. Install hangers adjacent to motor driven equipment with vibration isolation.

G. Prime coat exposed steel hangers and supports.

H. Utilize floor cleats where slotted steel channels are secured to the structure.

3.6 FIELD QUALITY CONTROL

A. All hydronic water piping systems shall be installed, examined, inspected, and tested in accordance with the requirements of ASME 31.9.

B. Perform tests and inspections and prepare test reports.

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with fluid, and are fully operational before introducing chemicals for water-treatment.
3. Place hvac water treatment systems into operation and calibrate controls during the preliminary phase of systems start-up procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion being tested.
6. Leave uncovered and unconcealed all new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed.
7. Cap and subject piping to static water pressure of 50-psig above operating pressure, without exceeding the pressure rating of system materials.
8. Isolate test source and allow test pressure to stand for 4-hours. Leaks and loss in test pressure constitute defects.
9. Repair leaks and defects with new materials and retest piping until no leak exists.

C. System Pressure and Leak Test:

1. All new, altered, extended, or replaced piping shall be tested hydrostatically at 100 psig for a period of not less than 6-hours. Isolate and protect all equipment not designed to withstand the test pressure.
2. Repair any leaks that may occur and repeat the test procedure. No insulation shall be installed until piping has passed pressure testing.
3. Prepare and submit separate reports for each test, complete with diagram or description of section tested and any corrective action taken.

3.7 SCHEDULES

A. Heating Water Above Grade Piping:

1. Pipe Sizes Up to 2 Inches: Steel Pipe or Copper Tube
2. Pipe Sizes Over 2 Inches: Steel Pipe

B. Chilled Water Above Grade Piping:

1. Pipe Sizes Up to to 2 Inches: Steel Pipe or Copper Tube
2. Pipe Sizes Over 2 Inches: Steel Pipe

C. Hanger Spacing for Copper Tubing:

1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch and 1-1/4 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

D. Hanger Spacing for Steel Piping:

1. 1/2 inch thru 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 2120 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Buffer tanks.

B. Expansion tanks.

C. Air separators.

D. Strainers.

E. Balancing valves.

F. Autoflow valves.

G. Relief valves.

H. Pressure reducing valves.

I. Magnetic filters.

J. Air vents.

K. Test plugs.

L. Access covers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All reference amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Schedules: Provide schedules for all calibrated balancing valves and/or flow verification devices supplied for the project. Include a list of scheduled flow rates, corresponding pipe sizes, and pressure differentials.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of all flow controls, valves, and air vents.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 STORAGE AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 BUFFER TANKS

A. Manufacturers:

1. Amtrol Inc.
2. Taco, Inc.
3. Wessels Company.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1A, rated for working pressure of 125 psi. And NPT vent connection shall be fitted to the top and an NPT drain connection shall be fitted to the bottom of the vessel.

C. Chilled water buffer tanks shall include two ports and be fitted with an internal baffle to circulate water taking full advantage of the tan volume.

D. Heating water buffer tanks shall be offered with two ports or four ports allowing hydraulic separation.

2.2 EXPANSION TANKS

A. Manufacturers:

1. Amtrol Inc.
2. Taco, Inc.
3. Wessels Company.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to scheduled psi.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.3 AIR SEPARATORS

A. Manufacturers:

1. Spirotherm, Inc.
2. Taco, Inc.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Full flow coalescing type, steel construction, rated for 150 psig working pressure, stamped in accordance with ASME (BPV VIII, 1), with integral full port float actuated brass venting mechanism at top of venting chamber.

2.4 STRAINERS

A. Manufacturers:

1. Metraflex Company.
2. Watts Water Technologies.
3. Zurn Industries.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, wye-pattern with 1/32 inch stainless steel perforated screen. Provide additional screens as may be required by the specific equipment manufacturers installation requirements.

C. Size 2-1/2 inch to 4 inch:

1. Provide flanged or grooved iron body for 175 psi working pressure, wye-pattern with 1/16 inch stainless steel perforated screen. Provide additional screens as may be required by the specific equipment manufacturers installation requirements.

2.5 BALANCING VALVES

A. Manufacturers:

1. Armstrong.
2. IMI Hydronic Engineering (TA).
3. Victaulic Company.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Size 2 Inch and Smaller:

1. Calibrated variable orifice, wye-pattern, globe style with threaded or soldered ends, 300 psi non-ferrous DZR brass copper alloy body, EPDM O-ring seals, four-turn hand-wheel with digital readout, locking tamper-proof memory setting, and connections for portable differential meter.

C. Size 2-1/2 Inch and Larger:

1. Calibrated variable orifice, wye-pattern, globe type with flanged or grooved ends, 300 psi ASTM A536 ductile iron body with all other parts of a DZR brass copper alloy, EPDM O-ring seals, minimum eight-turn hand-wheel with digital readout, locking tamper-proof memory setting, and connections for portable differential meter.

2.6 AUTOFLOW VALVES

A. Manufacturers:

1. IMI Hydronic Engineering.
2. Victaulic Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Design: The flow control shall be factory set and shall automatically limit the rate of flow to within 5% of the specified flow rate over at least 95% of the control valve range. Each valve shall have two P/T ports, arranged to provide a reading of the differential pressure across the flow limiting mechanism

C. Cartridge: Internal wear surfaces of the valve cartridge shall be 303 stainless steel. The cartridge body shall have machined threads so the spring free height may be compensated for without the use of fixed shims. A crimped sheet metal design is not acceptable. The internal flow cartridge shall be permanently marked with a code to identify the gpm and spring range.

D. Sizes Up to 2 Inches:

1. Dezincification resistant brass (DZR) or bronze wye-pattern body, integral chrome plated brass-body ball valve, and o-ring type union fitting.

E. Sizes 2-1/2" and Larger:

1. Ductile iron flanged body suitable for mounting wafer style between standard 150# or 300# flanges. Flange bolts and nuts shall be provided with each valve.

F. Autoflow balancing valves are permitted only where two-position control valves are specified, where 3-way control valves are indicated, and where calibrating flow thru dual coils at air handlers. Coordinate submittals and installation with the temperature controls contractor.

2.7 RELIEF VALVES

A. Manufacturers:

1. Armstrong International.
2. Watts Regulator Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.8 PRESSURE REDUCING VALVES

A. Manufacturers:

1. Armstrong International.
2. Watts Regulator Company.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Bronze body construction with internal components of stainless steel or brass and engineered plastics or composition material. provide integral check valve and strainer.

C. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve.

D. Operating Pressure Range: Between 10 psi and 25 psi.

2.9 AIR VENTS

A. Manufacturers:
1. Spirotherm, Inc.
2. Taco, Inc.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Float type: Brass body, non-ferrous float, viton seal and o-ring, suitable for 150 psig working pressure and 270F operating pressure.

2.10 TEST PLUGS

A. Manufacturers:
1. Peterson Equipment Company.
2. Sisco Manufacturing Company.
3. Ferguson Enterprises.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene or EPDM rated for minimum 200 degrees F.

C. Application: Use extended length plugs to clear insulated piping.

PART 3 EXECUTION

3.1 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. Install specialties in accordance with manufacturers instructions.

C. Install manual air vents at system high points, at down feed elbows, and where indicated.

D. For manual air vents installed high-up, or within ceiling spaces or other concealed locations, provide vent tubing and extend tubing with coin key vent fitting to an accessible location.

E. Install ball-cock isolation valves at all automatic air vents. Where installed high-up or concealed, install vent tubing to the nearest drain.

F. Install strainers upstream of heating equipment and terminal devices install blow-down valves with hose threads and cap at all locations in the boiler room.

G. Install air separator on suction side of system circulation pump and connect to expansion tank. Install valved drain and hose connection at blowdown.

H. Install valved drain and hose connection on strainer blow down connections.

I. Install balancing valves and flow verification valves with three to five diameters of straight pipe upstream and downstream of device or per manufacturer's instructions.

J. Install pressure and temperature test ports upstream and downstream of all coils, heat exchangers, temperature control valves, and other locations as indicated.

K. Install relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks, and where indicated. Pipe relief valve outlet to nearest floor drain.

L. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

M. Pipe relief valve outlet to nearest floor drain.

N. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.2 FLOW BALANCE APPLICATION

A. Manual four-turn valves, autoflow valves, and pressure independent control valves (PICV) may be used for flow balancing only. Do not use for circuit isolation. The following stipulations apply:

   1. Autoflow type balance valves may only be used where fixed flow, two-position control is required, where three-way valves are indicated, and when calibrating flow thru stacked coils

   2. All other flow regulation shall use 4-turn or pressure independent control valves (PICV).

      a. Systems using pressure independent control valves require no other balancing devices, but do require flow measurement.

      b. Systems using pressure dependent control valves shall use manual 4-turn balance valves.

B. Combination venturi / shut-off valves may be used for isolation and flow measurement only. Do not use for balancing.

C. This contractor shall coordinate submittals and installation with the controls contractor.

END OF SECTION

SECTION 23 2130 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System lubricated circulators.

B. Vertical in-line pumps.

C. Integral variable speed controllers.

D. Pump specialty fittings.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each product, include construction materials, rated capacities, performance curves, operating characteristics, electrical characteristics, and furnished specialties and accessories. Include certified performance curves with operating points plotted on the curves.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

1.5 INFORMATIONAL SUBMITTALS

A. Start-up service reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

B. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owners name and registered with the manufacturer.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed that are packaged with protective covering for storage and identified with labels describing contents.

1. Extra Pump Seals: One spare set for each unit installed.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps and accessories of each type through one source from a single manufacturer.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Comply with UL 778 for motor operated water pumps.

1.9 STORAGE AND HANDLING

A. Retain manufacturers protective covers for flanges and protective coatings during storage.

B. Protect bearings and couplings against damage from sand, grit, and other foriegn matter.

C. Comply with pump manufacturer's written rigging instructions.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide hydronic pumps of the type, rotational speed, and arrangement indicated and scheduled; each rated to deliver the capacity indicated against the head of the systems it operates. Efficiencies shall be equal to or greater than the efficiency of the scheduled pumps at the scheduled design conditions.

B. Provide each centrifugal pump with an impeller whose diameter is 90% or less of the maximum impeller which the manufacturer shows in published pump curves. Pump selection shall be such that variation of plus or minus 15% of head estimated can be accomplished by trimming impellers by the manufacturer.

C. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

D. Provide each pump with a constant speed or variable speed premium efficiency motor, wound for operation on the current characteristics indicated in the schedule. Size each motor with relation to the impeller so that the required brake horsepower will not exceed the rated motor horsepower at any point on the pump curve.

2.2 SYSTEM LUBRICATED CIRCULATORS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Grundfos: grundfos.us.com
2. Taco, Inc: taco-hvac.com.
3. Wilo, llc: wilo-usa.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Type: Horizontal shaft, single stage, direct connected with multiple speed or integrated variable speed wet rotor motor for in-line mounting, for 140 psi maximum working pressure, 230 degrees F maximum water temperature.

C. Casing: Cast iron, bronze, or stainless steel with flanged pump connections.

D. Impeller, Shaft, Rotor: Stainless Steel.

2.3 VERTICAL IN-LINE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Armstrong Pumps Inc: armstrongpumps.com.
2. Taco, Inc: taco-hvac.com
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Description: Factory assembled and tested, centrifugal, overung impeller, separately coupled inline pump designed for installation with pump and motor shafts mounted vertically.

C. Pump Construction:

1. Casing: Radially or horizontally split cast iron with seal flush connection, threaded gauge tappings at inlet and outlet, and threaded or flanged connections.
2. Impeller: Cast iron, bronze, or stainless steel, fully enclosed, statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specific performance for constant speed pumps.
3. Shaft: Carbon or stainless steel with impeller cap screw and bronze or stainless steel shaft sleeve.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat, with NBR, EPDM, or FKM rubber bellows and gasket.

2.4 INTEGRAL PUMP MOTOR VARIABLE SPEED CONTROLLERS

A. Where scheduled, provide pumps with an integral pump motor speed controller.

1. Controller: Integrated controls complete with a menu-driven graphical user interface. Supports direct communication with the building management system with built-in support for BACnet MS/TP and IP protocols.
2. Commissioning and pump setup access via a user interface located on the face of the speed controller including display and adjustment of mode set values and locks out unauthorized adjustment.

3. Electronics providing constant curve duty, constant speed control, constant pressure control (delta-p/c), and variable differential pressure control (delta p/v). Speed regulation ca also be controlled via remote 0-10 Vdc by the BAS.
4. Rated for continuous duty with built-in startup circuit. Provide overcurrent, line surge, and current limit protection, thermal monitoring, heat sink status, and over temperature protection.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Guides: Angle pattern, cast-iron body and end cap, rated for 175 psig working pressure, with inlet vanes, 20 mesh startup strainer, 1/8" bronze or stainless steel permanent strainer, drain plug, and factory fabricated support.

B. Triple Duty Valve: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet, rated for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

C. Specialty fittings are to be supplied by the pump manufacturer to match the scheduled pumps.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine rough-in for piping systems to verify actual locations of piping connections before pump installation.

B. Verify that electric power is available and of the correct characteristics.

3.2 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. Install in accordance with manufacturer's instructions.

C. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

E. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized soft seat check valve and shut-off valve on pump discharge.

F. Check, align, and certify alignment of base mounted pumps prior to start-up.

G. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

H. Install flexible connectors on suction and discharge side of base pumps between pump casing and valves.

I. On pumps with integral drives, rotate the drive to be visible and accessible from the front of the pump with a minimum of 24-inches of clearance.

J. Support with floor-mount pipe and flange supports only where mfgr suggests.

K. Lubricate pumps before start-up.

3.3 CONNECTIONS

A. Connect piping to pumps. Install suction and discharge pipe sizes equal to or greater than the diameter of pump nozzles. Decrease from line size with long radius reducing elbows or reducers. Install valves that are the same size as piping connected to the pumps.

B. Install shut-off valves and wye-type strainer and/or suction diffuser on suction side of pumps as detailed. Remove temporary strainers after system cleaning.

C. Install shut-off valve, soft seat check valve, and balancing valve, or combination pump discharge valve on discharge side of pumps as detailed.

D. Install piping, pressure gauge, and gauge cocks at tappings across suction diffuser, pump suction, and pump discharge to measure suction, discharge, and/or differential pressures from a single liquid-filled gauge.

3.4 START-UP SERVICE

A. Provide factory authorized start-up and software programming services. Submit start-up service reports.

B. Complete installation and start-up checks according to manufacturer's written instructions.

1. Check piping connections for tightness.
2. Clean strainers on all suction piping.
3. Verify pump bearing lubrication.
4. Verify pump is free to roatate by hand.
5. Verify pump is rotating in the right direction.

C. Prime pumps by opening suctions valves. Start motor and open discharge valves slowly.

3.5 BAS INTERFACE

A. Factory install and/or setup the interface for BACnet communications. Provide any field installation labor required (internal/external module mounting, external module enclosure, wiring between the module and the boilers, and power wiring).

B. Connect the interface’s EIA-485 port to the BAS. Provide any onsite setup/configuration labor necessary to enable the BACnet communications and/or to map the specified data into BACnet objects.

C. Provide onsite assistance to the BAS contractor (in addition to any written documentation provided) concerning device addressing, BACnet services to be used, interpretation of the mapped object property information (definition of each data type, engineering units, on/off state definitions, etc), object and property types used, and object instance numbering.

3.6 SCHEDULES

A. See equipment schedules on the drawings for Basis of Design.

END OF SECTION

SECTION 23 2310 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Refrigerant piping and fittings.

B. Refrigerant piping specialties.

C. Refrigerant.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Include data on pipe and fittings, joining materials, assembly of specialties, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record exact locations of piping and refrigeration accessories on record drawings.

B. Field Quality Control Reports: Prepare testing and inspection reports documenting all testing procedures and outcomes.

C. Operation and Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.6 QUALITY ASSURANCE

A. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 STORAGE AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

2.2 REFRIGERANT PIPING

A. Copper Tube: ASTM B280, Type ACR or ASTM B88, Type K or L.

1. Fittings: Wrought copper, brazed joint: ASME B16.50.
2. Solder Filler: ASTM B32 95-5 tin-antimony or alloy HB solder.

B. Copper Tube: ASTM B88, ACR Type K, annealed 7/8-inch diameter and smaller.

C. Pressure-Seal-Joint Fittings:

1. UL 207 copper housing certified for field installation.
2. O-Rings: HNBR or compatible with specific refrigerant.
3. Tools: Manufacturer's approved special tools.
4. Minimum Rated Pressure: 700 psig.

D. Pipe Supports and Anchors:

1. Provide hangers and supports that comply with MSS SP-58. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
3. Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Supports: Slotted channel framing with insulated strut clamps.
5. Hanger Rods: Mild steel threaded both ends or continuous threaded.
6. Vertical Support: Steel riser clamp.

2.3 PIPING SPECIALTIES

A. Expansion Valves:

1. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system. Size valves to provide full rated capacity of cooling coil served. Coordinate valve selection with evaporator and condenser units.

B. Filter/Dryer:

1. On liquid lines 3/4 inch and larger, filter/dryer shall be replaceable core type with non-ferrous casing and schrader type valve. On lines smaller than 3/4 inch, filter/dryer shall be a sealed type using sweat copper fittings. Size shall be full line size.

C. Sight Glass:

1. Combination moisture and liquid indicator with cap. Sight glass shall be line size, of solid copper or brass. Coated steel is not allowed.

D. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends.

E. Flexible Connections:

1. Connectors shall be for refrigerant service with bronze seamless corrugated hose and bronze braiding.

2.4 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

B. All refrigerant piping specialties shall be designed for use with and have materials compatible with refrigerants scheduled on the drawingsquired. Pressure rating for all accessories shall be 500 psi minimum.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Conform to ASME B31.9 for installation of piping system.

B. Install refrigeration specialties in accordance with manufacturer's instructions.

C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and avoid interference with use of space.

E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

F. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40-percent in direction of flow.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Flood piping system with nitrogen when brazing.

I. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

J. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

K. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

L. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

M. Provide service valves on each liquid and suction line connection where valves are not supplied as integral to the equipment.

N. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

O. Fully charge completed system with refrigerant after testing.

P. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

Q. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

R. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow and at equipment. Do not support piping from equipment.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration systems in accordance with ASME B31.5.

B. Test refrigerant piping, specialties, and receivers. Isolate components not suitable for the test pressures.

C. Test refrigerant piping using dry oil-free nitrogen and prove tight at the pressures listed below. Maintain test for 12-hours with no leakage or reduction in gauge pressure.

D. Line test pressure for refrigerant R-410-A:

1. Suction lines for air conditioning applications: 300 psig.
2. Suction lines for heat-pump applications: 535 psig.
3. Hot-gas and liquid lines: 535 psig.

E. Request witness by a member of the design team or the general contractor. Prepare testing and inspection reports and submit documentation of all testing procedures and outcomes.

F. Evacuation: Reduce absolute pressure on both sides of the system simultaneously to 300 microns; then charge the system with proper refrigerant until 0-psi is obtained. Repeat the evacuation-charging procedure two more cycles, then maintain 300 microns for 2-hours before final charging with refrigerant.

G. Request witness by a member of the design team and submit a report documenting all testing procedures and outcomes, inlduding dates and times.

3.4 SYSTEM CHARGING

A. Pull a system vacuum down to at least 1000 microns (+/- 50 microns) and close the vacuum header valves.

B. If the 1000 micron vacuum holds for 30-min, break the vacuum with dry nitrogen to a pressure of 2 psig. Install core in filter dryers after leak test but before evacuation.

C. Install system suction and liquid drier cores, and pull a second vacuum to a minimum of 500 microns and close the vacuum header valves.

D. If the 500 micron vacuum holds for 30-min, then break the vacuum with the refrigerant to be used in the system to a pressure of 2 psig.

E. Pull a third vacuum to a mnimum of 300 microns. Close the vacuum header valves and allow system to stand for a minimum of 24-hrs.

F. If the 300 micron vacuum holds for 24-hrs with a maximum drift of 100 microns over the 24-hr period, then the system is ready to be charged with refrigerant.

G. Break the vacuum with the refrigerant to be used in the system and charge the system with refrigerant. Add oil to the compressors, oil separator, and oil reservoirs, if equipped.

H. Request witness by a member of the design team and submit a report documenting all testing procedures and outcomes, including dates and times.

3.5 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high and low pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

3.6 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 2510 - HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Chemical treatment.

C. Chemical feeder equipment.

D. Glycol feed system.

E. Glycol charge.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Qualifications Data: Submit documentation that the water treatment provider and field specialists meet the quality assurance qualifications of this section.

D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

1.4 CLOSEOUT SUBMITTALS

A. Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment. Describe all activities and document pertinent results.

B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, having a minimum of 10-years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Provider Qualifications: Company specializing in water analysis, installation of water treatment equipment, and application of water treatment as specified in this section, having a minimum of 5-years of experience, and approval of the chemical manufacturer.

C. Pre-Qualified Treatment Specialists:

1. Subject to compliance with requirements, provide services by one of the following:

a. HTO Chemical Co, Lander, WY; (307) 330-7631.

b. Substitutions: See Section 20 0050 for substitution procedures.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Water quality shall minimize corrosion, scale build-up, and biological growth for optimum efficiency of equipment without creating a hazard to operating personnel or to the environment.

B. Base water treatment on quality of water available at the project site, equipment material characteristics, and functional performance characteristics, operating personnel capabilities, and requirements of authorities having jurisdiction.

C. Closed hydronic systems, including heating water and/or chilled water with glycol, shall have the following water qualities. Confirm all water qualities specifications with the equipment manufacturers prior to treatment.

1. pH: Maintain a value within 6.5 to 9.0.

2. Alkalinity: Maintain a value within 100 to 300 ppm.

3. Boron: Maintain a value 100 to 200 ppm.

4. Soluble Copper: Maintain a maximum value of 0.20 ppm.

5. Total Suspended Solids: Maintain a maximum value of 10 ppm.

6. Ammonia: Maintain a maximum value of 20 ppm.

7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.

8. Microbiological Limits:

a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.

b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.

c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.

d. Sulfate Reducers: Maintain a maximum value of 0 organisms/mL.

e. Iron Bacteria: Maintain a maximum value of 0 organisms/mL.

D. Chemicals: As recommended by the water treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in the performance requirements article.

E. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental stabilizer additives for mixing with water and suitable for operating temperatures from minus 20°F to 250°F.

2.2 WATER ANALYSIS REPORTS

A. Water analysis reports shall be submitted for every step of the process specified herein. Confirm all water qualities specifications with the equipment manufacturers prior to treatment. Each report shall include at a minimum:

1. General:
    a. pH.
    b. Glycol volume percent
    c. Solution freeze point
    d. Reserve alkalinity
    e. Total dissolved solids
2. Degredation Products:
    a. Iron (Fe), ppm.
    b. Copper (Cu), ppm.
    c. Aluminum (Al), ppm.
    d. Zinc (Zn), ppm.
3. Scale Promotors:
    a. Magnesium (Mg), ppm.
    b. Calcium (Ca), ppm.
4. Contaminants:
    a. Silica (SiO2), ppm.
    b. Nitrate (NO3), ppm.
    c. Molybdenum (Mo), ppm.
    d. Lead (Pb), ppm.
    e. Arsenic (As), ppm.
5. Corrosives:
    a. Chloride (Cl), ppm.
    b. Sulfate (SO4), ppm.
    c. Acidity (organic).
6. Inhibitors:
    a. Phosphate (PO4), ppm
    b. Boron (B), ppm.

c. Nitrite (NO2), ppm.

d. Tolyltriazole (TTZ), ppm.

e. NACAP (MBT), ppm.

2.3 SYSTEM CLEANER:

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Rhomar Water Management, Inc: rhomarwater.com
2. AmSolv/Division of Amrep, Inc: amsolv.com.
3. Nalco Company: nalco.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.

C. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite.

D. Heating water cleaning agents shall be listed for use with aluminum (multi-metal) heat exchangers where applicable. Basis of design is Hydro-Solv 9259 as manufactured by Rhomar Water Management.

2.4 CLOSED SYSTEM TREATMENT:

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Rhomar Water Management, Inc: rhomarwater.com
2. AmSolv/Division of Amrep, Inc: amsolv.com.
3. Nalco Company: nalco.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Sequestering agent to reduce deposits and adjust pH; polyphosphate.

C. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

D. Conductivity enhancers; phosphates or phosphonates.

E. Heating water treatment agents shall be listed for use with aluminum (multi-metal) heat exchangers where applicable. Basis of design is Pro-Tek AL for aluminum and multi-metal closed loop systems as manufactured by Rhomar Water Management.

2.5 BY-PASS FILTER FEEDER

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Griswold Controls

2. J. L. Wingert Company
3. Vector Industries
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Carbon steel body, epoxy powder coating, quick opening cap, working pressure of 200-psi at 200°F. Quarter-turn or threaded fill cap with gasket seal. Install ball valve isolation on inlet and outlet. Install drain tee with ball valve isolation, hose thread fitting, and cap.

C. Provide a 25-micron pleated sock-filter for start-up and two 10-micron filters for system operation.

2.6 GLYCOL FEED SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:
1. Advantage Controls: advantagecontrols.com.
2. J.L. Wingert Company: emersonswan.com.
3. Neptune Chemical Pump Company, Inc: neptune-pumps.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Glycol System: A completely preassembled packaged glycol feed system, consisting of a 50 gallon polyethylene tank, 1/3 hinged polyethylene lid, carbon steel enamel painted frame, NEMA 4X control panel, low level float switch, and dry contact alarm.

C. Feeder Pump: Single bronze rotary gear 1/3 HP pump, with a capacity of 1.5 gallons per minute at a pressure of 100 psi, with pressure switch, relief valve, check valve, suction strainer, braided hose, and discharge piping.

2.7 GLYCOL SOLUTION

A. Inhibited propylene glycol and water solution mixed to the proportions scheduled on the drawings, suitable for operating temperatures from -20 degrees F to 250 degrees F. Do not use glycol solutions pre-mixed with inhibitors or other chemicals.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform a water analysis of the existing heating water systems to determine a baseline.

B. Perform a water analysis of supply water to determine the quality of water available at the site.

C. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

D. Place terminal control valves in open position during cleaning. Bypass boilers and any other equipoment not designed to accept the cleaning process.

3.2 DESCRIPTION

A. Design a water treatment program to satisfy requirements of the equipment manufacturers.

B. Fill any make-up water tanks with treated water at the completion of the initial water treatment.

C. Provide all chemicals and a service program for a period of one year from the completion date of the initial water treatment.

D. Sample treated water systems at a 6-month interval following the initial water treatment. If samples are more than 10% out-of-range, repeat the water treatment process and document any adjustments.

3.3 INSTALLATION

A. All hydronic systems shall be thoroughly cleaned to rid the system of dirt, pipe compound, mill scale, oil residue, and any other foreign material, prior to placing the system in operation. All equipment not designed to accept the cleaning chemicals shall be bypassed during the cleaning process.

B. This contractor shall install or arrange to have installed all required chemical feeding equipment, chemical feeder tanks, and all necessary piping valves, controls, wiring, motors, and starters.

C. Install chemicals and equipment in accordance with manufacturers instructions.

D. Systems shall be tested and certified to meet performance requirements specified herein.

E. Include a non-oxidizing biocide to inhibit biological development.

F. Perform tests determining strength of glycol and water solution and submit written test results.

3.4 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.

B. Flushing and Cleaning:

1. Isolate all equipment not designed to accept the cleaner. Install temporary bypass piping at each boiler, chiller, and other equipment as directed by the manufacturer.

2. To avoid creating clogs, open all balancing valves and control valves, remove any flow cartridges, release diaphragms on any differential pressure devices, etc.

3. Flush direct return branches individually with all other branches valved off to avoid low velocity sections of pipe where sediment will accumulate.

4. Circulate cleaner by isolating direct return branches one at a time. Do not circulate with all direct return branches open simultaneously.

5. Add inhibitor and other additives in a similar manner to insure a complete mix.

C. Install temporary bypass piping around all equipment not designed for the cleaning and flushing chemicals.

D. Flush open systems and glycol filled closed systems with clean water. Isolate all direct return branches and flush each individually. Drain system completely and refill.

E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

F. Remove, clean, and replace strainer screens.

3.5 GLYCOL INSTALLATION

A. Glycol Installation: If necessary, feed pre-mixed propylene glycol solution to the systems. Water used for dilution shall have a total hardness hardness of less than 50 ppm and a total chloride and sulfate of less than 25 ppm. The contractor shall perform tests on the building potable water supply to confirm that it is suitable.

B. Perform tests to determine the strength of the propylene glycol solutions before the systems are turned over to the owner. Provide another test prior to the end of the first year and replenish as required.

C. Setup the glycol feeder control for proper operation. Set the pressure switch to feed the glycol solution to the system at the system fill pressure.

3.6 SCHEDULES

A. Heating Water: 30% inhibited propylene glycol / 70% water.

B. Chilled Water: 30% inhibited propylene glycol / 70% water.

END OF SECTION

SECTION 23 3110 - HVAC METAL DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rectangular ducts and fittings.

B. Round ducts and fittings.

C. Sheet metal materials.

D. Internal duct liner.

E. Sealants and gaskets.

F. Hangers and supports.

G. Duct leakage testing.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Flexible duct.

C. Delegated Design:

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. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings.

1.7 QUALITY ASSURANCE

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA (DCS) and performance and design criteria indicated in this section.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA (DCS) and ASCE/SEI 7.

C. Duct Leakage Tests: Comply with SMACNA HVAC Air Duct Leakage Test Manual. Test 100% of all ducts with a pressure class of greater than 3-inch water gauge.

1.8 STORAGE AND HANDLING

A. Inspect shipments to insure ductwork is undamaged and complies with the specification.

B. Protect from moisture, dirt, dust, construction debris, and foreign materials. Where end caps or packaging is provided, take precaution so protection remains in place and free from damage.

C. Ductwork shall be kept sealed and cleaned prior to and after installation. All ductwork not kept clean, in the opinion of the design team, will be replaced at no additional cost to the project.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All ductwork shall be constructed to be free from vibration, chatter, objectionable noise or pulsations, and leakage under specified operation conditions.

B. Use material, weight, thickness, construction, support, and installation methods as outlined in the above listed SMACNA publications.

C. Duct pressure classification and sealing requirements shall be as specified herein. Where not indicated, follow requirements in SMACNA publications.

D. Duct sizes indicated on the drawings are net inside dimensions. Where sizes are not indicated, the duct segment size shall be equal to the largest duct segment to which it is attached.

E. Pressure Class Requirements:

1. Variable Volume: Unless otherwise indicated, the pressure class for variable volume system ductwork upstream of the air terminal units shall be equal to the static pressure at the fan discharge, but not less than 4-inches water gauge.
2. Constant Volume: Unless otherwise indicated, the pressure class for constant volume system ductwork shall be equal to the static pressure at the fan discharge, but not less than 2-inches water gauge.
3. The minimum allowable pressure class for all other ductwork, positive or negative, is 2-inches water gauge.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA (DCS) for materials involved, duct-support intervals, and other provisions, based on indicated static-pressure class, and sealing requirements stated herein.

B. Longitudinal Seams: Select seam types and fabricate according to SMACNA (DCS), Figure 2-2, "Rectangular Duct/Longitudinal Seams."

1. Longitudinal seams shall be flat crimped Pittsburgh lock (SMACNA Type L1) with specified sealant applied over seams.

C. Transverse Joints: Select joint types and fabricate according to SMACNA (DCS), Figure 2-1, "Rectangular Duct/Transverse Joints."

1. Transverse joints in ducts 24-inches and under on the longest side may be slip and drive type or flanged.
2. Transverse joints in ducts exposed to view and concealed ducts larger than 24-inches shall be flanged.

D. Branch Connections: Comply with SMACNA (DCS), Figure 4-6, "Branch Connections."

1. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Rectangular Main to Round Branch: Conical spin-in or high-performance type.

E. Elbows: Comply with SMACNA (DCS), Figure 4-2, "Rectangular Elbows."

1. Use radius throat, radius heel elbows (SMACNA Type RE 1) with a minimum centerline radius to width ratio of one and one half times.
2. Where 1.5 radius elbows will not fit, use short radius elbows (SMACNA Type RE 3) with a minimum centerline radius to width ratio of one times and two radius proportional splitter vanes installed within.
3. Where radius elbows will not fit or where shown on the drawings, use rectangular mitered elbows (SMACNA Type RE 2) with vanes complying with SMACNA (DCS), Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

F. Transitions, Offsets, and Other Duct Construction: Select types and fabricate according to SMACNA (DCS), Chapter 4, "Fittings and Other Construction."

2.3 SINGLE-WALL ROUND DUCT AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA (DCS), Chapter 3, "Round, Oval, and Flexible Duct," for materials involved, duct-support intervals, and other provisions, based on indicated static-pressure class, and sealing requirements stated herein.

B. Longitudinal Seams: Select seam types and fabricate according to SMACNA (DCS), Figure 3-2, "Round Duct Longitudinal Seams."

1. All exposed round duct shall be spiral lock-seam (SMACNA Type RL1) with gored elbows. No snap-lock or longitudinal seams are permitted.

C. Transverse Joints: Select joint types and fabricate according to SMACNA (DCS), Figure 3-1, "Round Duct Transverse Joints,"

1. Use beaded sleeve joints (SMACNA Type RT1) with minimum 2-inch insertion length, or flanged joints (SMACNA Type RT2 or RT2A).

2. Transverse joints in concealed ducts 24-inches and larger in diameter and exposed ducts 12-inches and larger in diameter shall be flanged.

D. Tees and Laterals: Select types and fabricate according to SMACNA (DCS), Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees."

1. Use 45-degree lateral or combination taps. Where velocities are less than 1000 feet per minute, conical tees may also be used.

2. Saddle taps are permitted in existing ducts only.

E. Elbows: Comply with SMACNA (DCS), Figure 3-4, "Round Duct Elbows."

1. Use radius elbows with a minimum centerline radius to diameter ratio of one and one half times. Where 1.5 radius elbows will not fit and velocity is 1200 feet per minute or lower, use 1.0 radius elbows.

2. Round elbows shall be welded, segmented type. Elbows 10-inches and smaller may be stamped. Adjustable elbows are not permitted, unless approved in writing by the engineer, and then only with the gores fixed and thoroughly sealed.

2.4 SHEET METAL MATERIALS

A. General Requirements: Comply with SMACNA (DCS) 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 A653.

1. Galvanized Coating Designation: G90.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A1008, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304 or 316; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated.

E. Reinforcement Shapes and Plates: ASTM A36, steel plates, shapes, and bars; black and galvanized.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. CertainTeed Corporation: certainteed.com.
2. Johns Manville Corporation: jm.com.
3. Knauf Insulation: knaufusa.com.
4. Owens Corning Corporation: ocbuildingspec.com.
5. Substitutions: See Section 20 0050 for substitution procedures.

B. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

C. Maximum Thermal Conductivity:

1. Type I, Flexible: 0.27 at 75 deg F mean temperature.
2. Type II, Rigid: 0.23 at 75 deg F mean temperature.

D. Water Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

E. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating.

F. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

G. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.6 SEALANT AND GASKETS

A. General Requirements: Surface-burning characteristics for sealants and gaskets shall have a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723.

B. Joint and Seam Sealant: Water-based, indoor or outdoor service, water resistant, mold and mildew resistant, maximum 75 g/L VOC content, compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. Strap and Rod Sizes: Comply with SMACNA (DCS), Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

D. 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.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Galvanized-steel shapes and plates for galvanized steel ducts.

G. Channel Support System: Shop or field fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans indicate general location and arrangement of duct systems. Install duct systems as closely as possible to that indicated unless deviations to layout are approved in writing.

B. All air distribution ductwork shall be fabricated, erected, and supported, in accordance with applicable standards of SMACNA, where such standards do not conflict with NFPA 90A, and where class of construction equals or exceeds that noted herein.

C. Duct systems have been designed for metal ducts. Fibrous glass duct (duct board) may not be substituted for metal duct.

D. Install ducts with the fewest possible joints. Install round and flat-oval ducts in maximum practical lengths.

E. Limit transition angles to 15-degrees diverging and 30-degrees converging (each side).

F. Install ducts vertically and horizontally, 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 flanges and insulation thickness.

I. Route ducts to avoid passing through electrical equipment rooms and enclosures.

J. Install sheet metal flashing collars where ducts are exposed to view (including mechanical rooms) and where ducts pass thru walls, floors, or ceilings.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements for fire and smoke damper ratings.

L. All ductwork, including low pressure ductwork, shall be sealed to SMACNA Seal Class A with all joints, seams, and penetrations sealed, unless otherwise indicated.

M. Do not install duct sealants when temperatures are less than recommended by sealant manufacturers. Maintain temperatures during and after installation of duct sealant.

N. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

O. Install liner within ducts where indicated, noted, or detailed. Rectangular supply air ducts exposed above partial "cloud" ceilings shall be lined instead of insulated.

P. Provide an appropriately sized wood frame “window-buck” to the mason for each masonry penetration with location dimensions permanently indicated.

Q. Install all automatic control dampers and other devices furnished by the BAS contractor. See the BAS specifications for installation requirements.

3.2 FLEXIBLE CONNECTIONS

A. Connections to inlet and discharge openings of fans shall be made with a section of at least 1/16-inch thick neoprene coated fiberglass fabric. Flex connections shall not be less than 3-inches long and shall have at least 1-inch of slack.

B. Connections shall have angle frames at each end for rectangular ducts, and metal tension bands at each end for round ducts.

C. Connections shall be installed on straight duct sections, not transitional fittings, and allow for easy replacement.

D. Connections to units that have internally isolated fans within the unit housing will not require flex connections, unless otherwise indicated.

3.3 APPLICATION OF DUCT LINER

A. Comply with SMACNA (DCS), Chapter 7, "Flexible Duct Liner Installation."

B. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area.

C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

D. Butt transverse joints without gaps, and coat joint with adhesive.

E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

G. Secure liner with mechanical fasteners 4-inches from corners and at intervals not exceeding 12-inches transversely; at 3-inches from transverse joints and at intervals not exceeding 18-inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "z-profiles" or are integrally formed from the duct wall. Fabricate edge facings at fan discharges, and intervals of lined duct preceding unlined duct.

I. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional; when used, secure build-outs to duct walls with bolts, screws, rivets, or welds.

3.4 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Utilize flange connection systems with corner clips or optional nuts and bolts. Install in strict accordance with manufacturer's instructions.

C. Trim duct gaskets and sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA (DCS), 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.

C. Hanger Spacing: Comply with SMACNA (DCS), Table 5-1, "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. All supports shall be from joists, beams, or other structural members. Do not support from roof decking. Install channel framing to span bar joists.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.

F. Install upper attachments to structure. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Straps may be used to support rectangular ducts 60-inches wide or smaller. Use trapeze hangers with rods and angles or channel to support rectangular duct larger than 60-inches wide.

H. Where hangers are exposed to view, use angle or channel supports with threaded rod.

I. Use double nuts and lock washers on threaded rod supports.

3.6 DUCT LEAKAGE TESTING

A. Testing equipment, procedure and reports shall be in accordance with the latest edition of the SMACNA HVAC Air Duct Leakage Manual.

1. Equipment shall include, but not be limited to, a blower with volume control, manometer, and orifice meter with pressure differential manometer.

2. Ductwork shall be tested in partial segments as work progresses before concealment and application of external insulation.

3. Manometer readings shall be converted to cubic feet per minute from a calibrated test curve.

B. The following ducts shall be tested:

1. Supply air ducts with a pressure classification of greater than 3-inches water gauge shall be tested with a leakage classification as scheduled herein.

2. Test duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

C. Design pressure for testing ductwork shall be determined from the maximum pressure generated at the fan discharge at the nominal motor horsepower installed or the stated pressure class, whichever is greater.

D. Leaks identified during inspection or testing shall be repaired.

1. All leaks shall be found audibly or visually with smoke.

2. All leaks shall be repaired or the joints remade, and testing repeated until acceptable results are achieved.

3. Leaks shall be repaired by complete removal of the sealant materials, thorough cleaning of the joint surfaces, and reinstallation of multiple layers of sealing materials.

E. All low pressure duct systems, positive or negative, shall be inspected for visual and audible signs of leakage.

F. Leaks that cause objectionable noise in the opinion of the Owner or engineer, must be repaired regardless of the amount of leakage.

G. The contractor shall notify the design team 7-days in advance of when duct pressure testing is planned so the Owner or engineer has the option to observe the tests.

3.7 DUCT CLEANING

A. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

B. Ductwork shall be kept sealed and cleaned prior to and after installation. All ductwork not kept clean, in the opinion of the architect, will be replaced at no additional cost to the project.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums, scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and drains.

3.8 SCHEDULE

A. Primary Supply Air Ducts (upstream of variable volume terminal units):

1. Material: Galvanized sheet steel.
2. Pressure Class: Positive 4-inches water gauge.
3. Seal Class: A, all joints, seams, and penetrations sealed.
4. Leakage Class: 4 rectangular, 2 round.

B. Secondary Supply Air Ducts (downstream of variable volume terminal units):

1. Pressure Class: Positive 2-inches water gauge.
2. Seal Class: A, all joints, seams, and penetrations sealed.

C. Return Air and Outdoor Air Ducts:

1. Pressure Class: Negative 2-inches water gauge.
2. Seal Class: A, all joints, seams, and penetrations sealed.

D. Exhaust Air and Relief Air Ducts:

1. Pressure Class: 2-inches water gauge, positive or negative.
2. Seal Class: A, all joints, seams, and penetrations sealed.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

F. Liner:

1. All Ducts: Fibrous glass, Type I, 1-inch thick, where indicated.

END OF SECTION

SECTION 23 3300 - HVAC DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire dampers.

B. Backdraft dampers.

C. Duct access doors.

D. Insulated flexible duct.

E. Flexible connections.

F. Branch connections.

G. Volume control dampers.

H. Turning vanes.

I. Pipe portal systems.

J. Equipment support rails.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Drawings: Record actual locations of access doors and test holes.

B. Operation and Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views, etc.

1.6 QUALITY ASSURANCE

A. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 STORAGE AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

B. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 FIRE DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc: louvers-dampers.com.
2. Nailor Industries Inc: nailor.com.
3. Pottorff: www.pottorff.com
4. Ruskin Company: ruskin.com.
5. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated. Penetrations through barriers with fire resistance ratings of less than 3-hrs shall be protected by 1.5-hr rated dampers. Penetrations through barriers with resistance ratings of 3-hrs or more shall be 3-hr rated dampers.

C. Frame: Hat-shaped channel, rool formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 13 gauge U-channel type frame. Low profile head and sill on sizes less than 13-inches high.

D. Blades: 6-inch maximum width, double skinned true air foil, roll formed galvanized steel. Structurally equivalent to 14 gauge.

E. Jamb Seals: Stainless steel, flexible metal compression type.

F. Axles: Minimum 1/2" diameter plated steel hex-shaped, mechanically attached to blade.

G. Bearings: Self-lubricating stainless steel, sleeve-type turning in extruded hole in frame.

H. Linkage: Concealed in frame.

I. Release Temperature: 165 ºF.

J. Mounting: Vertical and/or Horizontal (1½ hour rated only)

K. Sleeve: Minimum 16-inches long x 20-gauge, factory installed.

2.2 BACKDRAFT DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc: louvers-dampers.com.
2. Nailor Industries Inc: nailor.com.
3. Ruskin Company: ruskin.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Manufacturers:
1. Elgen Manufacturing: elgenmfg.com.
2. Nailor Industries Inc: nailor.com.
3. Ruskin Company: ruskin.com.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install 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: Provide two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.4 INSULATED FLEXIBLE DUCT

A. Manufacturers:
1. Hart and Cooley: hartandcooley.com
2. Thermaflex: thermaflex.net
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabrication: UL 181, Class 1, two-ply vinyl or black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
1. Carlisle HVAC Products: carlislehvac.com.

2. Elgen Manufacturing: elgenmfg.com.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabrication: In accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd, approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

2.6 BRANCH CONNECTIONS

A. Manufacturers:

1. Hercules Industries: herculesindustries.com.
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Rectangular sheet metal branch duct take-offs shall be fabricated with 45 degree entry fittings in accordance with SMACNA standards. Branch ducts shall include opposed action type multi-blade dampers where indicated on the drawings.

D. Sheet metal take-offs between rectangular and round ductwork shall be with conical bell-mouth type spin-ins, where duct sizes permit. Each fitting shall have a single blade quadrant locking damper as an integral part of the fitting. Fittings shall be Hercules bell-mouth spin-in, Hercules high efficiency take-off, or equivalent.

2.7 VOLUME DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Hercules Industries: herculesindustries.com.
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

F. Quadrants: Provide locking, indicating quadrant regulators on single and multi-blade dampers. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. Where volume dampers are inaccessbile due to hard ceilings or other reasons, provide cable operated dampers with ceiling brackets and cover plates.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Ductmate Industries: ductmate.com.
2. Durodyne: durodyne.com.
3. Substitutions: See Section 20 0500 for substitution procedures.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 PIPE PORTAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Portals Plus, Inc: commercialproducts group.com
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Pipe portal system shall include an 18 gauge galvanized roof curb with integral base plate, continuously welded corner seams, factory-installed wood nailer, and 1-1/2 inch rigid fiberglass insulation.

C. An EPDM compression molded cap shall be utilized. All caps shall include stainless steel snaplock clamps.

D. Attachment and installation of the pipe portal shall be done in accordance with the manufacturer's instructions and the roofing membrane manufacturer's instructions.

2.10 EQUIPMENT SUPPORT RAILS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Roof Products and Systems: commercialproductsgroup.com
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Equipment rails shall be fabricated of 18 gauge galvanized steel with built-in cant, monolithic construction with integral base plate and continuous mitered and welded corner seams, with factory installed wood 2x4 nailer.

C. Each equipment rail shall include a matching 18 gauge galvanized steel counter-flashing cap with integral drip edge, all corners mitered and welded, with screws for attachment.

D. Equipment rails over 3 feet long shall incorporate 14 gauge internal gussett reinforcing. Rail height to provide 6" clearance above the final roof surface, with a vertical step at the bottom (contractor verified) for insulation thickness.

PART 3 EXECUTION

3.1 DUCT 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. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to the Ductwork section for duct construction and pressure class.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

H. Provide volume dampers to all ducted air devices, whether indicated or not. Mount at the branch take-off where noise will not be detectable at the device. Provide cable operated dampers where duct branches are inaccessible for adjustment.

I. Provide volume dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

3.2 FLEX DUCT INSTALLATION

A. Install insulated flexible ducts in accordance with SMACNA (DCS).

B. Support with bands 1-1/2" wide and spaced a maximum of 48-inches apart. Maximum centerline sag between supports shall not exceed 1/2-inch per 12-inches.

C. Do not bend flexible ducts across sharp corners, and avoid contact with fixtures, water lines, and conduits.

D. Install fully extended, in a direct line, without sags, twists, or turns. Bends shall not be less than one duct diameter.

E. Connect to diffusers and metal ducts with maximum 60-inch lengths of flexible ducts clamped or strapped in place.

1. Tape the inner liner to the hard duct or device collar.

2. Attach two nylon straps; one on the inner liner and one for the outer shell.
3. Fold the outer shell inside itself before wrapping the hard duct.
4. Install hard duct elbows at diffusers or "flexflow" radius forming elbows.

END OF SECTION

SECTION 23 3420 - POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof ventilators.

B. In-line cabinet fans.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts where applicable.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs, speed controllers, and other scheduled accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings. Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

B. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Certified performance ratings determined in accordance with AMCA 210 and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705.

1.7 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Greenheck Fan Corporation: www.greenheck.com
2. Loren Cook Company: www.lorencook.com
3. PennBarry: www.pennbarry.com
4. Twin City Fans: www.tcf.com
5. Substitutions: See Section 20 0500 for substitution procedures.

2.2 ROOF VENTILATORS

A. Centrifugal Fan Unit: Direct driven or V-belt driven as indicated; heavy gauge, removable, spun aluminum housing; resilient mounted, permanently lubricated ball bearing motor; aluminum fan wheel hub and blades; one-piece, square hinged, aluminum base with curb gaskets.

B. Housing:

1. Down-blast Units: Spun aluminum, dome top and outlet baffle.
2. Up-blast Units: Spun aluminum discharge baffle directing air upward, with drains.
3. Tiered Down-blast: All aluminum housing with extruded aluminum tiers.

C. Accessories: (where indicated)

1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside the fan housing, factory wired through an internal aluminum conduit.
2. Speed Controller: Solid-state variable control to reduce speed to less than 50 percent.
3. Bird Screens: Aluminum 1/2-inch square mesh with removable frame.

4. Dampers: Counterbalanced, parallel-blade, aluminum construction with offset hinge pin, and nylon bearings, mounted in curb base.

D. Belt Drives: (where indicated)

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley, dynamically balanced.

E. Roof Curb: Galvanized steel; mitered and continuously welded corners with mounting flange; 1-1/2-inch rigid fiberglass insulation; 1-1/2-inch wood nailor; with damper tray where applicable.

1. Provide 12-inch curbs unless indicated otherwise.
2. Coordinate roof pitch and overall height with roof deck construction.

2.3 CABINET AND CEILING EXHAUST FANS

A. Fan Unit: Centrifugal V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor .

C. Grille: Molded white plastic or aluminum with baked enamel finish as indicated. .

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 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. Install power ventilators level and plumb, in accordance with manufacturer's instructions. Install units with clearance for service and maintenance.

C. Secure roof-mounted fans to roof curbs with cadmium-plated steel lag screws.

D. Support cabinet fans from structure with resilient mountings and flexible electrical leads.

E. Extend ductwork into the curb for roof-mounted exhausters and seal air-tight to roof opening.

F. Install cabinet fans with flexible connections between fan and ductwork.

G. Replace fan and motor pulleys as required to achieve final air balance.

H. Install backdraft dampers on inlet to roof and wall exhausters.

I. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

SECTION 23 3610 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single-duct, pinch-off, variable volume units.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.

2. Include rated capacities, operating characteristics, electrical characteristics, sound data, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of units and locations of access doors required for access of valves and controls.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

C. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

PART 2 PRODUCTS

2.1 SINGLE DUCT VARIABLE VOLUME UNITS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Krueger: krueger-hvac.com.
2. Metal-Aire: metalindustriesinc.com.
3. Titus: titus-hvac.com.
4. Tuttle and Bailey: tuttleandbailey.com.
5. Substitutions: See Section 20 0500 for substitution procedures.

B. General:

1. Factory assembled, AHRI 880 rated, variable air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

C. Unit Casing:

1. Construction: Minimum 22 gauge galvanized steel.
2. Air Inlet Collar: Round or rectangular, suitable for standard duct sizes.
3. Unit Discharge: Rectangular, with slip and drive connections.
4. Casing Liner: 1/2-inch thick, 1-1/2-lb dual density, coated, fibrous-glass complying with ASTM C1071, UL181, and NFPA 90A.
5. Access Panel: In the unit casing for viewing of damper components and/or upstream cleaning of the hot water coil.

D. Damper Assembly:

1. Heavy gauge, galvanized steel or extruded aluminum construction with solid shaft rotating in bearings.
2. Provide indicator on damper shaft or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak damper blades for tight airflow shutoff.

E. Flow Sensor:

1. Unit shall be equipped with a factory installed flow sensing device. Provide a four quadrant, multi-point center averaging sensor with an amplified signal.
2. Provide balancing taps to allow for easy airflow verification.

F. Hot Water Heating Coil:

1. Coil Casing: Minimum 20 gauge galvanized steel, factory installed on terminal unit with rectangular outlet, slip and drive connection.
2. Fins: Corrugated heavy gauge aluminum, mechanically bonded to seamless, copper tubes. Coils shall be leak tested to minimum 350 psig.
3. Performance: Number of rows and circuits shall be selected to provide performance as scheduled on the drawings. Performance data shall be based on tests run in accordance with AHRI 410.
4. Capacity: Water and airflow performance characteristics listed within the equipment schedules on the drawings.

G. Control Transformers:

1. Factory supplied and mounted for electric and electronic control applications.

H. Controls:

1. DDC controls supplied and installed by the BAS contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as shown on the drawings.

3.2 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. Install in accordance with manufacturer's instructions.

C. Install air terminal units according to NFPA 90A. Install units level and plumb.

D. Maintain sufficient clearance for normal service and maintenance.

E. Provide ceiling access doors or locate units above easily removable ceiling components.

F. Provide minimum of 5 ft of 1 inch thick lined ductwork downstream of units.

G. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows.

H. Hanger and Support Installation:

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, and with applicable sections of these specifications.
2. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
3. Hangers Exposed to View: Threaded rod and angle or channel supports.

4. Attachments: 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.

I. Service Clearance:

1. Plan and coordinate locations to avoid service conflicts with piping, lighting, sprinkler heads, and other components.
2. Unless noted otherwise, provide a minimum of 36" of working clearance area on the control panel side.
3. Where terminal units or their working clearance fall near sprinkler heads, the heads shall be installed with flexible pipe drops for temporary relocation. Coordinate installation with the sprinkler contractor.
4. Where terminal units or their working clearance fall above light fixtures, the fixture shall be installed with a flexible whip for temporary relocation. Coordinate installation with the electrical contractor.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 CLEANING

A. Vacuum clean coils and inside of units.

B. Install new filters in fan-powered units.

END OF SECTION

SECTION 23 3710 - GRILLES REGISTERS AND DIFFUSERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grilles, registers, and diffusers.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of product.

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. Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Krueger: krueger-hvac.com.
2. Metal-Aire: metalindustries.com

3. Price: priceindustries.com.
4. Titus: titus-hvac.com.
5. Substitutions: See Section 20 0500 for substitution procedures.

2.2 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square and rectangular, multi-louvered diffuser to discharge air in two way and four way pattern .

B. Connections: As scheduled on drawings.

C. Frame: Provide surface mount and inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Aluminum with baked enamel finish.

E. Color: As shown on drawings.

2.3 LINEAR SLOT DIFFUSERS

A. Type: Continuous width slot with adjustable vanes for left, right, or vertical discharge. Number of slots and width scheduled on the drawings.

B. Fabrication: Aluminum extrusions with factory clear lacquer finish.

C. Color: As shown on the drawings.

D. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket, mitered end border.

E. Plenum: Integral, galvanized steel, insulated.

F. Damper: Where dampers are inaccessible, provide manufacturer's cable operated dampers with mounting brackets.

2.4 SURFACE SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades to discharge air along face of grille, two-way deflection.

B. Frame: 1 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions with factory enamel finish.

D. Color: As shown on drawings.

E. Damper: Where scheduled, integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.5 EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.

B. Fabrication: Steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory enamel finish.

C. Frame: 1 inch margin with countersunk screw mounting.

D. Color: As shown on the drawings.

E. Damper: Where scheduled, integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.6 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 x 1/2 x 1/2-inch grid core.

B. Fabrication: Grid core consists of aluminum with baked enamel finish.

C. Color: As shown on the drawings

D. Frame: 1-1/4 inch margin with countersunk screw mounting.

E. Frame: Channel lay-in frame for suspended grid ceilings.

PART 3 EXECUTION

3.1 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. Install in accordance with manufacturer's instructions. Install level and plumb.

C. Ceiling-Mounted Outlets and Inlets:

1. 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.

2. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel.

3. Make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

D. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, extractors, and fire dampers.

E. After installation, adjust diffusers, grilles, and registers to air patterns indicated, or as directed, before starting air balancing.

F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, where dampers are not specified as part of the air device assembly.

G. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 23 5110 - GAS VENTS AND CHIMNEYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Listed double wall type B vents.

B. Single wall polypropylene vent systems.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

B. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.
2. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

C. Underwriters Laboratories:

1. UL 441 - Standard for Gas Vents.
2. UL 1738 - Standard for Venting Systems for Gas Burning Appliances, Categories II, III, IV.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of product:

1. Include construction details, material descriptions, dimensions and weights of individual components, and connection requirements.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details. Detail fabrication and assembly of hangers and restraints.
2. Include factory provided itemized shop drawing with applied design layout details and all dimensions utilized for the stack sizing analysis.

D. Certified Sizing Calculations: Manufacturer shall provide certified, comprehensive venting system sizing calculation analysis for all conditions including firing rates, ambient temperatures, elevation and number of appliances.

E. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include manufacturers descriptive literature, installation instructions, maintenance and repair data, and parts listings.

B. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

B. Design Requirements: Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

D. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Source Limitations: Obtain listed system components through one source from a single manufacturer.

1.7 WARRANTY

A. Manufacturers lifetime warranty for the entire duration the product is incorporated and used in its original installation when properly installed per the manufacturers installation instructions.

PART 2 PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. DuraVent Inc: duravent.com.
2. Jeremias Inc: jeremiasinc.com
3. Shebler Company: shebler.com.
4. Chiminee Lining: chimineelining.com.
5. Substitutions: See Section 20 0500 for substitution procedures.

B. Description: Factory built modular chimney, tested and listed with UL 1738 for use with category II, III, & IV appliances with a maximum flue gas temperature of 550°F. Product must have a UL tested pressure rating of 40" w.c. Product to have leak-free guarantee for three years and lifetime warranty backed by the manufacturer.

C. Construction: Between the inner and outer shells there shall be a minimum of a 1" air gap. Stainless steel centering clips shall be welded to the outer shell to maintain the 1" spacing and ensure concentricity of the shells. Vent sections shall be sealed by use of a ½" flange to flange and factory applied gasket to gasket design. Flanges to be coupled using bands. No sealant is allowed for joints or variable sections allowing immediate start-up of appliance.

D. Inner Shell: Inner liner material shall be 24 gauge AL29-4C stainless steel. All inner shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted on any part or fitting.

E. Outer Jacket: All outer shell seams shall be 22 gauge 430 stainless steel. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted.

F. Accessories: UL labelled tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; indicated or not, all listed for same assembly. Specific accessories:

   1. Stack Cap / Termination: Consists of an open-top termination with wide bird screen opening.

   2. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.

   3. Adjustable or variable length sections where applicable, installed, oriented, and supported in full accordance with the manufacturer's installation and design criteria.

G. Provide optional lifting lugs on the top section with engineered rigging and structural lift point and load carrying validation to facilitate crane drop or pulley cable system for building and lifting the complete chimney.

H. Breeching and vent sections, when installed according to manufacturer's instructions, shall comply with national safety standards and building codes. Stacks terminating above the roof must terminate as required by code or NFPA 211.

I. Performance Certification:

   1. Provide an engineered vent design to confirm proper combustion performance in full accordance with the boiler manufacturer's requirements.

   2.

2.2 LISTED TYPE B VENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

   1. Metal-Fab Inc: mtlfab.com.

   2. Heatfab: heatfab.com.

   3. Substitutions: See Section 20 0050 for substitution procedures.

B. The vent shall be of the double-wall, factory-built type for use with approved Category I appliances burning natural or LP gas, which produce flue gases exhausted at temperatures not exceeding 550º F, with neutral or negative flue pressure complying with NFPA 211.

C. The vent shall be constructed of an outer wall of galvanized steel, .018" thick G-90 for sizes 3" to 14" diameter, and .024" thick G-90 for sizes 16" to 30" diameter.

D. The inner wall shall be constructed of aluminum alloy, .012" thick for sizes 3" to 8" diameter and .018" thick for sizes 10" to 30" diameter.

E. The vent shall include an integral, annular insulating air space, 1/4" thick for sizes 3" to 6" diameter and 1/2" thick for sizes 7" to 30" diameter.

F. Edges of inner and outer walls shall be hemmed prior to final assembly to prevent pipe and fittings from having exposed sharp edges. Walls shall be attached to maintain spacing and prevent separation of inner and outer walls.

G. The vent pipe shall incorporate a push-tab locking system to prevent disassembly of vent during or after installation. All fittings, flashing, storm collar, cap, and appliance adapter required to install the vent shall be included.

H. Vent shall be tested and listed for a minimum clearance to combustibles of 1" for sizes 3" to 24" diameter and 2" for sizes 26" to 30" diameter. Vent shall be installed and terminated in accordance with the vent manufacturer's installation instructions, UL listing, and state or local codes.

2.3 POLYPROPYLENE VENT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the work include, but are not limited to the following:

1. Centrotherm: centrotherm.us.com.

2. Substitutions: See Section 20 0050 for substitution procedures.

B. Description: UL 1738 listed, single wall, factory built type, designed for use with Category II or IV condensing gas fired appliances, or as specified by the heating equipment manufacturer. Listed for maximum possible pressure rating of 15-inches w.g. and maximum continuous flue gas temperature not to exceed 230-deg F.

C. All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be UL listed and provided by the vent manufacturer. All exterior components shall be UV-rated.

D. All systems components shall include a factory installed gasket in their female-end to render the vent air and water tight when ends are pushed together. Vent systems requiring field installed sealants or compounds are not permitted.

E. The vent system shall be continuous from the appliance’s flue outlet to the vent termination outside the building. Vent layout shall be designed and installed in compliance with manufacturer’s installation instructions and all applicable local codes.

F. The vent layout shall be designed and installed in compliance with the manufacturer's installation instructions and all applicable codes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

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

3.2 INSTALLATION OF LISTED VENTS

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. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Lap joints in direction of flow.

E. Erect stacks plumb to finished tolerance of no more than 1-inch out of plumb from top to bottom.

F. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

G. Install firestopping to preserve fire resistance rating of partitions and other elements.

H. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

END OF SECTION

SECTION 23 5210 - MODULATING CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing boilers and trim.

B. Boiler operating controls.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide data indicating general layout, dimensions, size and location of water, gas, and vent connections, and electrical characteristics and connection requirements.

1. General assembly drawing of the boiler including product description, model number, dimensions, clearances, weights, service sizes, etc.
2. Schematic wiring diagram of the boiler’s control system that shows all components, interlocks, etc. Clearly identify factory wiring and field wiring
3. Schematic flow diagram of the boiler’s gas valve train(s).

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Manufacturer’s Instructions: Provide manufacturer’s complete installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Startup Service Reports: Include results of tests and inspections, for initial startup and post construction validation.

B. Operation and Maintenance Data: For boilers, components, and accessories, to include shop drawings, product data, operating instructions, cleaning procedures, maintenance and repair data, complete parts list, etc.

C. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with a minimum of 20-years of documented experience.

1. Additional equipment features, details, accessories, appurtenances, etc which are not specifically identified but which are a part of the manufacturer's standard commercial product, shall be included in the equipment being furnished.
2. The equipment must fit within the allocated space, leaving ample allowance, as may be required by local or state codes, for maintenance and cleaning, and must leave suitable space for easy removal of all equipment appurtenances.
3. The equipment shall be new and fabricated from new materials. The equipment shall be free from defects in materials and workmanship.
4. All units of the same classification shall be identical to the extent necessary to insure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.

B. ASHRAE Compliance: Boilers shall conform to minimum combustion efficiency requirements according to ASHRAE 90.1.

C. ASME Compliance: Fabricate and label boilers to conform to ASME (BPV IV) and (BPV VIII) for boiler construction.

D. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

E. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 STORAGE AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. The contractor shall follow rigging instructions provided by the manufacturer and shall use all lifting points provided on the channel base of the unit.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within the specified warranty period.

1. The boiler's heat exchanger, pressure vessel, and condensate collection basin shall be warranted for a period of 10-yrs from the date of startup.
2. All other components shall be warranted for 1-yr from the date of startup.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide equipment indicated on the drawings, or comparable equipment subject to prior approval.

1. Lochinvar Corporation: www.lochinvar.com.

2. Substitutions: See Section 20 0500 for substitution procedures.

B. The project is based on the specified equipment as part of an overall system. Any additional re-engineering or installation costs associated with using alternate manufacturer's equipment shall be borne by the installing contractor, prior to approval of submittals.

2.2 CONDENSING BOILERS

A. The boiler shall be of a fire tube design and shall be vertically down fired. The boiler shall bear the ASME "H" stamp for 80 psi working pressure and shall be National Board listed. The heat exchanger assembly shall be fully welded through an automated process to ensure weld integrity. The 439 stainless steel combustion chamber and tubes shall be self cleaning and designed to drain condensation to the bottom of the heat exchanger assembly. A built-in stainless steel flue collector shall allow condensation to drain from the heat exchanger assembly and into the external condensate trap.

B. The boiler shall be certified and listed under the latest edition of the ANSI Z21.13 test standard for the US and Canada. The boiler shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the ASHRAE 103 Standard. The boiler shall operate at a minimum of 95% Annual Fuel Utilization Efficiency. The boiler shall be certified for indoor installation. The boiler's efficiency ratings shall be verified through third party testing by the Hydronics Institute Division of AHRI and listed in the AHRI Certification Directory.

C. The boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The boiler shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The boiler shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column.

D. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The boiler shall be equipped with; a temperature/pressure gauge, high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, return water temperature sensor, a UL 353 certified flue temperature sensor, outdoor air sensor, low water flow protection and built-in adjustable freeze protection.

E. The boiler shall feature a controller with a multi-colored graphic LCD display with Navigation Dial and Soft Keys for, password security, three loop temperature setpoints with individual outdoor air reset curves, pump delay with adjustable freeze protection, pump exercise, domestic hot water prioritization with DHW modulation limiting and USB PC port connection. The boiler shall be capable of controlling a variable speed boiler pump to keep a constant Delta T at all modulation rates. The boiler shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint, enable disable of the boiler, variable system pump signal and a 0-10VDC output of boiler modulation rate. The Boiler shall have a built-in “Cascade” with sequencing options for “lead lag” or “efficiency optimized” modulation logic, with both capable of rotation while maintaining modulation of up to eight boilers without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.

2.3 FLUE VENTING

A. Exhaust flue shall be Category IV approved polypropylene or stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boiler exhaust vent length must be able to extend to 100 equivalent feet.

B. Intake piping for all models must be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend to 100 equivalent feet.

C. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.

D. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.

2.4 QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for equipment support, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting performance, maintenance, and operation.

B. Installation shall be performed by the contractor in accordance with requirements of the applicable codes. Contractor shall review the boiler and installation for compliance with requirements and/or issues that may affect boiler performance. Installation should not proceed until unsatisfactory conditions have been corrected.

C. Installation should not proceed until unsatisfactory conditions have been corrected.

3.2 BOILER 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. Install in compliance with manufacturer's installation instructions.

C. Coordinate sizes and locations of bases with actual equipment provided.

D. Install floor mount boilers on cast-in-place concrete equipment bases.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Maintain any clear accessible space indicated on the drawings around and between the boilers.

G. Install separate devices furnished by the manufacturer and not factory installed.

H. Install components that were furnished loose with equipment for field installation.

I. Assemble and install boiler trim. Install wiring to field mounted devices.

J. Locate condensate collector directly behind each boiler and not to either side.

K. Provide all electrical control and power interconnect wiring and install in accordance with requirements of NFPA 70.

L. Provide all fuel gas vent and natural gas service piping and install in accordance with requirements of NFPA 54.

3.3 PIPING CONNECTIONS

A. Where installing piping adjacent to boilers, allow space for service and maintenance.

B. Connect heating water piping to boiler inlet and outlet with shutoff valve and union or flange at each connection.

C. Connect to boiler inlet with a balancing device, strainer, plugged tee with t/p port, and drain with valve.

D. Connect to boiler outlet with a check valve and plugged tee with t/p port.

E. Connect gas piping to boiler gas train inlet with a sediment trap, shutoff valve, and union. Piping shall be at least full size of gas train connection.

F. Connect condensate piping to boiler and vent connections with manufacturers recommended high temperature tubing or piping material.

G. Connect condensate drain downstream of neutralizer tank with PVC. Manifold and route to nearest floor drain.

H. Connect each drain connection with a full-size drain valve with hose threads and cap.

I. Install piping from safety relief valve to within 6-inches of the floor.

J. Extend relief piping from gas valve full-size to vent outdoors.

3.4 VENTING CONNECTIONS

A. Install flue venting system and combustion air intake in accordance with NFPA 54 per the manufacturer's recommendations. Connect full size to boiler connections.

B. Venting installation requirements are specified in other sections.

3.5 ELECTRICAL CONNECTIONS

A. Install an electrical disconnect and overload protection for each boiler in accordance with requirements of NFPA 70.

B. Connect wiring and ground equipment according to applicable electrical sections.

3.6 CONTROLS CONNECTIONS

A. Install control and power wiring to factory and field-mounted control devices.

B. Connect control wiring between boilers, boiler pumps, and other equipment to interlock operation as required to provide a complete and functioning system.

C. Where applicable, connect control wiring between boiler control interface and DDC system for remote monitoring and control of boilers.

D. Where necessary, provide and install an interposing relay for interlock of the boiler circulating pump with the boiler control.

3.7 BAS INTERFACE

A. Communications wiring, wiring of temperature sensors, and interlock wiring between each boiler and its circulation pump is to be provided under Division 25 (BAS).

B. Provide documentation to and coordination with the controls contractor concerning BAS communications wiring termination at the boiler control panel, proper use of each controller's data (Modbus registers or BACnet objects) for enabling/disabling the boiler system, interpretation, addressing, etc, and any questions concerning the preceding.

C. Meet with the Owner and the controls contractor to review the data list in this specification, the Modbus registers (or BACnet objects) used to represent this data, and the complete list of data available from the boilers. The purpose is to determine the Owner's preferences concerning the actual data to be communicated and viewable/modifiable by the BAS.

D. Perform an integrated sequence of operation test with the controls contractor to assure that the overall sequence (in combination with that required for the BAS's boiler system control) operates as specified. Work with the controls contractor to modify operation as needed to ensure that the overall sequence is met.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components; equipment installation, piping, controls, and electrical connections for proper assembly, installation, and connection.

C. Visually inspect boilers for damage before starting. Repair or replace damaged components. Do not start boilers until damage that is detrimental to operation has been corrected.

D. Complete installation and startup checks according to manufacturer's written instructions. At a minimum perform the following:

1. Test and adjust all boiler and burner interlocks, actuators, valves, controllers, gauges, thermometers, pilot lights, switches, etc. Any malfunctioning component shall be replaced.
2. Check and adjust initial operating set points and high and low-limit safety set points of fuel supply, water level, and water temperature.
3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
4. Adjust all parameters associated with ensuring that the control reacts properly to maintain setpoint but does not unnecessarily start/stop or short-cycle boilers on/off.
5. Where dedicated boiler pumps are indicated, adjust all parameters for proper control and adequate flow rates through all boiler operating conditions.

E. Prepare a written startup report that records results of tests and inspections.

1. Peform tests and inspections in accordance with manufacturer's instructions.

3.9 CLOSEOUT ACTIVITIES

A. Train Owner’s maintenance personnel to adjust, operate, and maintain the boilers.

B. Conduct training using actual equipment after treated system has been put into full operation.

C. Have operation and maintenance data available for use during training.

D. Instructor shall be factory trained and certified.

E. Train personnel in operation and maintenance.

F. Train personnel to obtain maximum efficiency in plant operation.

G. Provide for not less than 4-hrs of training and instruction.

H. Obtain Owner sign-off that training is complete.

END OF SECTION

SECTION 23 6420 - SCROLL-TYPE WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Factory assembled, air-cooled, scroll-type water chillers and controls.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a referenced standard shall be applicable to this project, unless identified by a specific edition date. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements, and wiring diagrams. Indicate minimum evaporator flow rate and minimum capacity without hot gas bypass.

C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and accessories required for a complete system. Provide diagrams for power, signal, and control wiring.

D. Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum outdoor air temperature for air-cooled chillers.

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, sections, and elevation views, drawn to no less than 1/4-inch 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 units will be attached.
2. Piping rough-in requirements.
3. Wiring rough-in requirements.
4. Access requirements

B. Manufacturer’s installation instructions.

1.6 CLOSEOUT SUBMITTALS

A. Startup Service Reports: Include results of tests and inspections.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

B. AHRI Compliance: Unit shall be rated in accordance with AHRI Standard 550/590, Standard for Water Chilling Packages using the Vapor Compression Cycle.

C. ASHRAE Compliance: Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

D. UL Compliance: Unit shall be certified in accordance with UL Standard 1995, Safety Standard for Heating and Cooling Equipment.

E. ETL Compliance: Unit shall be safety certified by ETL and be ETL USA listed. Unit nameplate shall include the ETL label.

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.

1.8 STORAGE AND HANDLING

A. Unit shall be shipped from the factory completely assembled, fully charged with refrigerant, and filled with oil.

B. Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.

C. Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location shall be followed.

D. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of units that fail in materials or workmanship within specified warranty period.

1. Complete assembly: Not less than 5-years from the date of startup, including all parts and labor.

2. Refrigerant: Not less than 5-years from the date of startup, including replacement for any reason.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide equipment indicated on the drawings, or comparable equipment subject to substitution approval as described in these specifications.

1. Aaon: aaon.com
2. Daikin: daikinapplied.com
3. Substitutions: See Section 20 0500 for substitution procedures.

2.2 UNIT DESCRIPTION

A. Factory-assembled, factory-charged air-cooled scroll compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic tandem scroll compressor sets, brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

B. Chiller shall be functionally tested at the factory to ensure trouble free field operation

2.3 DESIGN REQUIREMENTS

A. Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

B. Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F.

C. Performance: The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590. Performance is scheduled on the drawings.

D. Acoustics: Sound pressure and power levels for the unit shall not exceed performance specified on the schedules. All manufacturer's shall provide the necessary treatment to meet the basis of design. Tests shall be in accordance with AHRI Std 370.

2.4 COMPRESSOR

A. The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

2.5 EVAPORATOR

A. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates. Vent and drain connections shall be provided in the inlet and outlet piping by the installing contractor.

B. The evaporator shall be protected with an external, electric resistance heater plate and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F ambient air temperature.

C. The water-side maximum design pressure shall be rated at a minimum of 653 psig. Evaporators shall be designed and constructed according to, and listed by Underwriters Laboratories (UL).

2.6 CONDENSER

A. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

B. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water.

2.7 REFRIGERANT CIRCUIT

A. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

2.8 CONSTRUCTION

A. Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel. Painted parts shall be able to meet ASTM B117, 1000-hour salt spray test.

B. Upper section of unit shall have protective and decorative louvers covering the coils and unit end; base section of unit shall have protective, 12 GA, PVC-coated, wire grille guards and have painted steel wraps enclosing the coil end sections and piping.

2.9 CONTROL SYSTEM

A. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating.

B. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor

overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable.

C. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

D. Shall include high short circuit current rating of 65,000 amps (25,000 amps at 575Volt) with single-point disconnect switch

2.10 UNIT CONTROLLER

A. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

B. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

C. Shutdown Alarms

1. No evaporator water flow (auto-restart)
2. Sensor failures
3. Low evaporator pressure
4. Evaporator freeze protection
5. High condenser pressure
6. Outside ambient temperature (auto-restart)
7. Motor protection system
8. Phase voltage protection (Optional)

D. Limit Alarms

1. Condenser pressure stage down, unloads unit at high discharge pressures.
2. Low ambient lockout, shuts off unit at low ambient temperatures.
3. Low evaporator pressure hold, holds stage #1 until pressure rises.
4. Low evaporator pressure unload, shuts off one compressor.

E. Unit Enable Section

1. Enables unit operation from either local keypad, digital input, or BAS.

F. Unit Mode Selection

1. Selects standard cooling, ice, glycol, or test operation mode.

G. Analog Inputs:

1. Reset of leaving water temperature.
2. Current limit.

H. Digital Inputs

1. Unit off switch.
2. Remote start/stop.
3. Flow switch.
4. Motor protection.

I. Digital Outputs

1. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared.
2. Evaporator pump; field wired, starts pump when unit is set to start.

J. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

2.11 BUILDING AUTOMATION SYSTEM (BAS) INTERFACE

A. Factory mounted DDC controller(s) shall support operation on a BACnet® or Modbus® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.

B. BACnet IP, (Annex J).

C. The information communicated between the BAS and the factory mounted unit controllers shall include reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

D. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.12 OPTIONS AND ACCESSORIES

A. The following options are to be included:

1. Ground Fault Protection: Factory installed circuit breaker to protect equipment from damage from line-to-ground fault currents less than those required for conductor protection.
2. Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.
3. The following accessories are to be included:
    a. Waffle pad type or spring-type vibration isolators for field installation.
    b. Factory-mounted thermal dispersion type flow switch.
    c. Field-mounted, paddle type, chilled water flow switch field wired to the control panel.
    d. Wye strainer, to be installed at the evaporator inlet and sized for the design flow rate.
    e. 120V GFI convenience outlet field wired by the electrical contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine rough-in for equipment support, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

B. Water chiller locations indicated on the drawings are approximate. Determine exact locations before rough-in for piping, controls, and electrical connections.

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

3.2 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. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.

C. Install on support structure where indicated. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.

D. Maintain manufacturer's recommended clearances for service and maintenance. Maintain clearances required by governing code.

E. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

F. Install separate devices furnished by manufacturer and not factory installed.

3.3 PIPING CONNECTIONS

A. Where installing piping adjacent to chillers, allow space for service and maintenance.

B. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.

C. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve.

D. Make connections to water chiller with a flange or mechanical coupling.

3.4 ELECTRICAL CONNECTIONS

A. Ground equipment and connect power and control wiring according to applicable electrical sections of these specifications.

B. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

C. Connect control wiring between chillers control interface and BAS system for remote monitoring and control of chillers.

D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection.

3.6 BAS INTERFACE

A. Factory install and/or setup the interface for BACnet communications. Provide any field installation labor required (internal/external module mounting, external module enclosure, wiring between the module and the chiller, and power wiring).

B. Connect the interface's EIA-485 port to the BAS. Provide any onsite setup/configuration labor necessary to enable the BACnet communications and/or to map specified data into BACnet objects.

C. Provide onsite assistance to the controls contractor (in addition to any written documentation provided) concerning device addressing, BACnet services to be used, interpretation of the mapped object property information, object and property types used, object instance numbering, etc.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.

D. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that thermometers and gages are installed.
3. Operate water chiller for recommended run-in period.
4. Check bearing lubrication and oil levels.
5. Verify proper motor rotation.
6. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
7. Verify and record performance of chilled water flow and low-temperature interlocks.

8. Verify and record performance of water chiller protection devices.
9. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

E. Prepare a written startup report that records results of tests and inspections.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train the owner's maintenance personnel to adjust, operate, and maintain water chillers.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance.
4. Train personnel to obtain maximum efficiency in plant operation.
5. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
6. Obtain Owner sign-off that training is complete.
7. Owner training shall be held at the project site.

END OF SECTION

SECTION 23 7320 - MODULAR AIR HANDLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Modular indoor air handling units.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each air handling unit indicated.

1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Air Coils: Coil and frame configurations, dimensions, materials, rows, and connections, and performance at indicated conditions.
4. Fans: Performance curves at indicated conditions, fan construction and accessories, motor ratings and electrical characteristics.
5. Sound Power Level Data: Fan outlet, return inlet, and casing radiation at rated capacity.
6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings:

1. Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
2. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted.
3. Sound data for discharge, radiated, and return positions shall be submitted by octave band for each unit.

4. Calculations for required baserail heights to satisfy condensate trapping requirements of (future) cooling coils shall be provided.
5. Indicate custom opening locations and dimensions, to be confirmed by the contractor in the field.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan, elevation, and section views, drawn to no less than 1/4-inch scale, indicating equipment manufacturers service clearances, structure and base attachment, piping, ductwork, power, and controls, coordinated with each other using input from installers of the items involved. Each view shows a screened background with the following:
   1. Room layout with walls, floors, and roofs, including each room name and number.
   2. Column grids, beams, columns, concrete housekeeping pads, supports, and other adjacent structural and mechanical elements.
   3. Equipment and products of other trades that are located in vicinity of the air-handlers and are part of final installation, such as lighting, fire-suppression, and plumbing systems.

B. Manufacturers installation instructions.

1.6 CLOSEOUT SUBMITTALS

A. Startup Service Reports: Include results of tests and inspections.

B. Operations and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

C. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.7 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. Filters: Two sets for each air-handling unit. One clean set of air filters shall be installed at the time of substantial completion, after all commissioning has been completed and the system is turned over to the Owner. One clean set of air filters shall be turned over to the Owner for future use.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. AHRI Certification: Air-handling units and their components shall be factory tested according to AHRI 430, and shall be listed and labeled by AHRI.

D. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural steel support members with actual equipment provided.

1.10 STORAGE AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of units that fail in materials or workmanship within specified warranty period.

1. Complete assembly: Not less than 1-year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Daikin Applied.
2. Scott Springfield Manufacturing.

2.2 GENERAL DESCRIPTION

A. Factory fabricated assembly of modular sections consisting of housed centrifugal or plenum fans with belt or direct drives, coils, filters, and other necessary modules to perform one or more of the functions of circulating, cleaning, heating, cooling, humidification, dehumidification, and mixing of air with construction suitable for indoor or outdoor applications.

B. Components:

1. Casing construction.
2. Fan section.
3. Coil sections.

4. Filter section.
5. Access sections.
6. Air blender section.

C. Configuration: Fabricate as detailed on the drawings.

D. Performance: Conform to ARI 430. See schedules on prints.

E. Acoustics: Sound power levels (dB) for the unit shall provided with the submittal data.

2.3 UNIT CONSTRUCTION

A. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not permitted.

B. Panels and access doors shall be constructed as a 2-inch nominal thick; thermally broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.

1. The inner liner shall be constructed of G90 galvanized steel.
2. The outer panel shall be constructed of G90 galvanized steel.
3. The floor plate shall be constructed as specified for the inner liner.

C. Sound baffles shall be secured to the inner liner of selected fan, plenum, access, and manual sections. It shall be constructed of G90 galvanized perforated steel filled with 3 pound per cubic foot density, neoprene coated, glass fiber insulation.

D. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

E. The casing leakage rate shall not exceed 0.5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure.

F. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

G. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

H. A formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping. The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. Baserail height shall be determined by the largest pressure required to allow adequate condensate drainage. Should the unit baserail not be factory supplied at sufficient height, the contractor is required to supply a concrete housekeeping pad to make up the difference.

I. A round window inspection port shall be provided on unit section(s) as indicated on unit schedule and drawings.

2.4 FAN ASSEMBLIES

A. Acceptable fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door.

B. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry.

2.5 BEARINGS, SHAFTS, AND DRIVES

A. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be provided on the motor with the fan wheel mounted directly on the motor shaft, AMCA arrangement 4.

B. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

C. The fan wheel shall be direct coupled to the motor shaft. The wheel width shall be determined by motor speed and fan performance characteristics.

2.6 WATER COILS

A. Certification: Acceptable water cooling, water heating, steam, and refrigerant coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

B. Water heating coils shall be provided where scheduled. Provide access to coils for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5” beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

   1. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

   2. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a

continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

3. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of .025 inches.
4. Coil connections shall be carbon steel, threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.
5. Coil shall be furnished as an uncased galvanized steel track to allow for thermal movement and slide into a pitched track for fluid drainage.

2.7 FILTERS

A. Furnish angled filter in mixing box section with 2-inch pleated MERV 8 filter with microbial resistant Intersept coating. Provide side loading and removal of filters.

B. Filter media shall be UL 900 listed, Class I or Class II.

C. Filter Magnehelic gauges shall be furnished and mounted by equipment manufacturer.

2.8 ADDITIONAL SECTIONS

A. Access Sections: Where indicated on the drawings to allow for inspection, cleaning, and maintenance of field installed components. Construct access doors same as previously specified within this section.

B. Mixing Box Section: With end outside air opening and top return air opening with or without parallel ultra-low leak airfoil damper blades.

2.9 ELECTRICAL

A. Fan motors shall be manufacturer provided and installed, totally enclosed, premium efficiency (meets or exceeds EPAct requirements), 1750 RPM, single speed, 460V / 60HZ / 3Ph. Complete electrical characteristics for each fan motor shall be as shown in schedule.

B. The air handlers shall be ETL listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

C. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.

D. Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.

E. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.

F. All electrical connection components shall be field provided and mounted as shown on project schedule.

2.10 CONTROLS

A. All controls shall be field provided and installed by the temperature controls contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

3.2 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. Equipment Mounting: Install air-handling units on cast-in-place concrete equipment bases, with anchor bolts, set and level.

C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers.

D. Arrange installation of units to provide access space around air handling units for service and maintenance.

E. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under obervation.

F. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters prior to substantial completion.

G. Install filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters. Mount gauges outside of unit.

H. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

I. Install air-handlers on base-rails of sufficient height to allow adequate condensate trapping and drainage.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Heating and Chilled Water Piping:

1. Locate water supply at bottom of supply header and return water connection at top.
2. Provide manual air vents at high points complete with stop valve.
3. Ensure water coils are drainable and provide drain connection at low points.
4. Install shutoff valve and union or flange at each coil supply connection.
5. Install shutoff valve, balancing device, and union or flange at each coil return connection.
6. Make connections to coils with unions, flanges, or mechanical couplings.
7. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Condensate Piping:

1. Connect condensate drain pans using Type M copper tubing. Extend to nearest floor drain.
2. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Electrical Connections: Connect wiring and ground equipment according to applicable electrical requirements.

F. Control Connections: Install control and power wiring to factory and field-mounted control devices.

G. Connect duct to air-handling units with flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: Fill coils with water and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed, and that sections are bolted together with gaskets.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete.
4. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
5. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
6. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
7. Verify that outdoor and return air mixing dampers open and close, and maintain minimum outdoor air setting.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in the fully open position.
9. Comb coil fins for parallel orientation.
10. Install new, clean filters.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

C. Prepare a written startup report that records results of tests and inspections.

3.6 CLOSEOUT ACTIVITIES

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

1. Conduct training using actual equipment after systems have been put into full operation.
2. Have operation and maintenance data available for use during during training.
3. Obtain Owner sign-off that training is complete.

B. Cleaning: After completing system installation and startup service, and testing, adjusting, and balancing air-handling unit and air-distribution systems:

1. Clean air-handling units internally to remove foreign material and construction dirt and dust.
2. Clean fan wheels, cabinets, dampers, coils, and filter housings. Install new, clean filters.

END OF SECTION

SECTION 23 8110 - TERMINAL HEATING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric heaters.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

C. Samples: Color samples for initial selection for equipment with factory applied color finishes.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

B. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

C. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 PRODUCTS

2.1 ELECTRIC RADIANT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Ouellet Canada.
2. Marley Engineered Products.
3. TPI Corporation.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Assembly: UL listed and labelled, with thermal box and cover, and built-in controls.

C. Heating Elements: Enclosed copper tube element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material, in metal reflective cabinet.

2.2 ELECTRIC UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated on the drawings or comparable products by one of the following:

1. Ouellet Canada, Inc.
2. Marley Engineered Products.
3. TPI Corporation.
4. Substitutions: See Section 20 0500 for substitution procedures.

B. Assembly: UL listed and labelled assembly with terminal box and cover, and built-in controls.

C. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.

D. Cabinet: 0.0478-inch steel with easily removed front panel with integral air outlet and inlet grilles.

E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

G. Motor: Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.

H. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

PART 3 EXECUTION

3.1 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. Install in accordance with manufacturer's instructions.

C. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.

D. Protect finished cabinet units with protective covers during the balance of construction.

E. Cabinet Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

F. Electric Unit Heaters: Hang from building structure with hangers anchored to building. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

G. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters in all fan-driven units with replaceable filter media.

3.3 SCHEDULES

A. See equipment schedules on the drawings for Basis of Design.

END OF SECTION

SECTION 23 8125 - COMPUTER-ROOM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Computer-room air conditioning units.

B. Indoor evaporator with compressor.

C. Outdoor split system condensing unit.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

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. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately.

B. Product Data: Provide rated capacities, weights, electrical data, wiring diagrams, furnished specialties, and accessories.

C. Shop Drawings: Indicate assembly, dimensions, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and connections.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owners name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience .

1.7 STORAGE AND HANDLING

A. Accept products on site in factory-fabricated protective containers. Inspect immediately and report any damage or missing components.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of units that fail in materials or workmanship within specified warranty period.

1. Refrigeration compressors: Not less than 5-years.
2. Humidifiers: Not less than 3-years.
3. Control boards: Not less than 3-years.

PART 2 PRODUCTS

2.1 AIR COOLED, SPLIT-SYSTEM, FLOOR MOUNTED AIR CONDITIONING UNIT

A. Manufacturers: Subject to compliance with requirements, provide products indicated on the drawings or comparable products by one of the following:

1. Above Air Technologies.
2. Substitutions: See Section 20 0500 for substitution procedures.

B. Cabinet and housing:

1. Construction: Single-wall insulated panels installed in recessed pockets with formed frame.
2. Accessible panels shall utilize quarter-turn fasteners. All sheet metal shall be minimum 20 gauge with powder-coat paint finish.
3. Insulation and Adhesive: Fiberglass mat (1-inch thick) and high density closed cell foam (fan bulkhead, piping, and drain pan).
4. Drain pan: Stainless steel, insulated.
5. Air pattern: Front return / top discharge with adjustable grille.
6. Filter:Pleated 2-inch thick Merv-8.

C. Direct expansion cooling system:

1. Direct-expansion type system.
    a. Single circuit two-speed scroll compressor.
    b. R-410A refrigerant.

c. Overload protected

d. Installed with evaporator.

2. High refrigerant pressure safety switch.
3. Low refrigerant pressure safety switch.
4. Crankcase heater.
5. Thermal expansion valve with external equalizer.
6. Low ambient control option.
7. Additional options: Receiver.
8. Split system:

a. The unit shall include Type L-ACR refrigerant piping and Schrader valves.

b. Filter-driers and sight-glasses shall be shipped loose for field installation.

c. The unit shall ship with a factory nitrogen charge. Field relief of the nitrogen charge shall indicate that the unit was received in a leak-free state.

d. The installing contractor shall be responsible for all interconnecting piping, isolation valves, leak testing, and evacuating the combined system, and charging the system.

e. Refrigerant shall be provided by the installing contractor.

D. Coils:

1. Evaporator Coil:

a. Aluminum-plate fin and seamless copper tube in galvanized steel casing.

2. Condenser Coil:

a. Construction: Aluminum-plate fin and seamless copper tube in galvanized steel casing.

E. Humidifier

1. Electrode steam canister type humidifier with disposable canister, steam distributor, and fill and drain valves.
2. Single stage control with automatic flush cycle.

F. Supply fan:

1. Type: Backward-inclined, high efficiency impeller.
2. Motor: Direct drive, EC.
3. Direct Drive: Motor mounted resiliently in the fan inlet.
4. Fan/motor assembly shall be statically and dynamically balanced for quiet, vibration-free operation.

G. Condenser fan:

1. Type: Axial propeller.
2. Motor: Direct drive, variable speed.**ed**.

H. Motors:

1. Motor sizes: As indicated or such that the motor will not be required to operate in service factor range above 1.0.
2. Motor Bearings: Maintenance free through lifetime lubricated ball bearings
3. Efficiency: Premium or better.

I. Electrical:

1. Unit short-circuit current rating: 10 kA.
2. Factory-mounted, non-fused, locking-type air handling compartment disconnect.
3. Air handling compartment power connection: Single point power.
4. Condensing compartment power connection: Single point power.
5. Control power: 24VAC.

J. Controls:

1. Microprocessor based PLC controller.
    a. Control type: BACnet enabled controller for computer room DX systems.
    b. Controller: Modicon programmable DIN-rail mounted HVAC controller.
    c. Remote-mountable display terminal with push button navigation.
2. Field installed, wall mounted, temperature/humidity sensor.
3. BMS communication: User selectable BACnet MSTP, BACnet IP, and Modbus.

K. Accessories:

1. Field mounted condensate pump with 20-ft lift.
2. Dual internal float switches.
    a. Condensate pump mounting: Field Mounted.
    b. Condensate pump power: Fused connection at unit.
3. Probe-type water-leak detector.
4. Neoprene floor mounted vibration isolation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and roofs for suitable conditions where equipment will be installed.

B. Verify that proper power supply is available and of the correct characteristics.

C. Verify roughing-in for unit is coordinated with actual locations of piping, duct, and electrical connections before equipment installation.

3.2 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. Install in accordance with manufacturer's instructions.

C. Install in accordance with NFPA 90A and NFPA 90B.

D. Install refrigeration systems in accordance with ASHRAE Std 15.

E. Pipe condensate drains to nearest floor drain as shown on the drawings.

F. Complete manufacturer's pre-startup check list confirming unit is ready for startup.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Test and inspect components, assemblies, installation, and final connections.

C. Prepare and submit startup report to the manufacturer.

3.4 CLOSEOUT ACTIVITIES

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

1. Conduct training using actual equipment after systems have been put into full operation.
2. Have operation and maintenance data available for use during training.
3. Obtain Owner sign-off that training is complete.

B. Cleaning: After completing system installation and startup service, and testing, adjusting, and balancing:

1. Clean units internally to remove foreign material and construction dirt and dust.
2. Clean fan wheels, cabinets, dampers, coils, and filter housings. Install new, clean filters.

END OF SECTION

DIVISION

25

INTEGRATED AUTOMATION

SECTION 25 1500 - BUILDING AUTOMATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System architecture.

B. Digital controllers.

C. Communicating sensors.

D. Operator interface.

E. Software and programming.

F. Third party controls.

G. Power and control wiring.

H. Testing, commissioning, and training.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. Materials, equipment, installation, and workmanship shall comply with the most restrictive of local, state, and federal authority's codes and ordinances.

B. The latest edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

C. American Society of Heating, Refrigeration, and Air Conditioning Engineers:

1. ASHRAE Standard 55 - Thermal Environmental Conditions for Human Occupancy.
2. ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.
3. ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low Rise Residential Buildings.
4. ASHRAE Standard 135 - BACnet; A Data Communication Protocol for Building Automation and Control Networks.

D. National Fire Protection Agency:

1. NFPA 70 - National Electric Code.

E. Underwriters Laboratories:

1. UL 916 - Standard for Energy Management Equipment.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: For each type of product include the following:

1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

2. Product description with complete technical data, performance curves, and product specification sheets.

3. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

4. Installation, operation and maintenance instructions including factors effecting performance.

5. Each submitted piece of product literature shall clearly cross-reference specification and drawings that submittal is to cover.

6. When manufacturers cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be clearly indicated.

7. Data sheets for DDC Controllers and BACnet Routers shall include the BTL mark and the listing's BACnet Device Profile.

8. All data sheets shall be keyed to the shop drawing bill of materials lists.

C. Graphics Screens: Sample graphics for the controls included in this project.

1. Schematic representations of all controlled and/or monitored systems, equipment, points and relevant setpoints or parameters, and dynamic thermo-graphic floor plans with all space sensing points represented.

2. See the execution articles of this section for additional information and requirements.

D. Delegated-Design:

1. Subject to stated requirements, the contractor shall be responsible for design of the building automation systems, including but not necessarily limited to, architecture layout, communications networks, sizing and selection of valves, dampers, and actuators, and all instrumentation and devices.

2. The owner and the engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services performed or provided by such professionals.

1.5 INFORMATIONAL SUBMITTALS

A. Qualifications: Submit documentation that the system provider, programming specialist, and field installers meet the quality assurance requirements of this section.

B. Testing: Submit documentation that will be used to validate point-to-point tests and functional performance testing prior to requesting acceptance by the Owner or Engineer. Provide a description of all system acceptance tests along with the contractor's forms, checklists, procedures, and trends used in the testing.

C. Training: Submit course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. The Owner or Engineer will modify course outlines and materials if necessary to meet the Owner's needs.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manuals: At a minimum, include the following:

1. Written contractor's warranty.
2. End user licensing agreements.
3. Software maintenance agreements.
4. As-built versions of product data.
5. List of recommended spare parts lists.
6. Operating and maintenance cautions and instructions.
7. An operator's manual, which will include detailed instructions for all operations of the building automation system.
8. A programmer's manual, which will include all information necessary to perform programming functions.
9. All original issue documentation, software, and licensing for third-party hardware and software (where applicable).

B. Software Editors: Submit all software service tools used for operator interface, programming environment, networking, database management, etc used by the contractor to install the system, or needed to operate the system to its full capabilities.

1. All software shall be available and functional on the web server, operator workstations, and/or portable operator terminals where provided.
2. Software shall be the latest release available as of the date of substantial completion, licensed to the owner.
3. Provide digital backups for all software provided so that the owner may reinstall any software as needed.
4. Include all proprietary cables necessary for connecting to controllers.

C. Testing Documentation: Submit completed control system test forms, checklists, point-to-point logs, and functional performance testing documentation. Include screens shots and trend logs to validate that all programming is in accordance with the specifications.

D. Training Validation: Submit attendance logs, including dates and times, for each knowledge level and all training sessions held. Include written descriptions summarizing topics covered in each session.

E. Updates: Submit written validation (in the form of a letter) that all software, firmware, drivers, etc have been updated to the latest version release as of the date of substantial completion.

F. Licensing: Submit written validation (in the form of a letter) that all licensing and software maintenance fees, including installation labor, is being provided for the period listed herein.

G. Provide all of the above in both hard-copy and portable digital file formats (where applicable).

H. Where applicable, provide workstations, laptops, or tablets, fully configured, ready for use.

1.7 QUALITY ASSURANCE

A. General:

1. System shall be by a nationally recognized manufacturer of direct digital control systems and products, having published catalog literature, installation, operation, and maintenance manuals for all products intended for use.
2. Materials and equipment shall be the manufacturer's latest standard design that complies with specification requirements. All materials and equipment shall be new and from the same product line, unless otherwise specified.
3. All electrical work shall comply with the latest version of the National Electrical Code, and electrical divisions of this specification.
4. Provide electrical products that have been tested, listed and labeled by UL and comply with NEMA standards.

B. System Provider Qualifications:

1. Authorized and trained representative of the proposed system manufacturer.
2. Demonstrated experience on at least five projects of similar point-count, complexity, scope, and value.
3. Having service and maintenance staff stationed within 60-miles and assigned to support the project during the warranty period.
4. Having product parts inventory to support on-going system operation after the date of substantial completion.

C. Installer Qualifications:

1. Demonstrated experience with the installation of the proposed product line for not less than two years and not less than two projects of similar size and complexity. Submit names of proposed individuals and documented experience.
2. Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the manufacturer on that product line for installation and configuration.

D. Programmer Qualifications:

1. Demonstrated experience with programming of the proposed product line for not less than five years and not less than five projects of similar size and complexity. Submit names of proposed individuals and documented experience.

2. Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the manufacturer.

1.8 WARRANTY

A. Manufacturer and installer agree to repair or replace products that fail in materials or workmanship for a period of one year after the date of final acceptance.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.

B. Maintenance Service:

1. Maintenance service shall be provided thru-out the warranty period for all controls software, firmware, and hardware specified in the project, at no additional cost. Service all equipment per the manufacturer's recommendations.

2. Preventative maintenance shall be provided thru-out the warranty period in accordance with the hardware component manufacturer's requirements.

C. Normal Service:

1. Any malfunction, failure, or defect in hardware component, or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the Owner as follows:

a. Response by telephone to any request for service shall be provided within 8-hours during a normal 40-hour work week.

b. In the event the issue cannot be resolved remotely, at least one trained technician shall be dispatched to the project site within three (3) working days.

D. Emergency Service:

1. Any malfunction, failure, or defect in hardware component, or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the Owner as follows:

a. Response by telephone to any request for service shall be provided within 2-hours of the Owner's initial telephone request.

b. In the event the issue cannot be resolved remotely, at least one trained technician shall be dispatched to the project site within 4-hours of the initial request.

c. Emergency service during the warranty period shall be provided 24-hours per day, 7-days per week, with no exceptions and at no additional cost to the Owner.

E. Software:

1. Updates, security patches, or version upgrades to software and firmware shall be installed when available and as necessary to resolve discrepancies.

a. All system software, firmware, drivers, etc will be upgraded to the latest version release as of the date of substantial completion.

b. Provide any additional software upgrades after the date of final acceptance, including installation, at no additional cost to the Owner.

c. Install updates only after receiving Owner's written authorization.

F. Notice Given:

1. The contractor shall notify the Owner any time the contractor is on-site for service.

a. Notify Owner's personnel of all anticipated service work. No work affecting system operation shall commence unless express permission is granted.

b. After completed, a work order ticket describing in detail all the work performed, hours worked, and follow-up required, shall be forwarded to the owner's personnel.

G. Written Warranty:

1. The contractor shall submit with the Operation and Maintenance manual a written warranty addressed to the Owner, acknowledging all requirements stated herein, including annual software maintenance upgrades and licensing renewals (where applicable).

2. The contractor shall submit with the Operation and Maintenance manual a written end user software maintenance and license agreement filled out in the Owner’s name.

1.9 PRE-APPROVED MANUFACTURERS AND PROVIDERS

A. Subject to requirements specified herein, pre-qualified manufacturers and system providers are as follows:

1. Long Building Technology of Casper, WY.

a. Tridium N4 and Distech Controls.

b. Contact: Todd Kuhl, 307-265-5997, tkuhl@long.com.

2. Substitutions: See Section 20 0500 for substitution procedures.

B. BACnet Conformance: Unless noted otherwise, all of the products used shall be shown to meet BTL conformance requirements as part of the submittal process or the contractor shall select one of the other listed manufacturers in order to meet the requirements.

C. All DDC controls shall be by one manufacturer, except when controls are specified under another section (referenced as “controls provided with equipment," "factory-mounted controls," "manufacturer provided controls," etc within this section). The term “DDC controls” includes DDC Controllers, BACnet Routers, and Operator Interface software. Field devices and EIA-485-to-IP routers need not be by the same manufacturer.

D. Open Licensing: The Owner shall be the named license holder of all DDC Device and Operator Interface software/firmware provided on this project. The intent of this requirement is to provide an open system such that products from various suppliers can be integrated into this BAS; and to allow the Owner or any contractor of their choosing to have full access to the system for expansion, maintenance, and service. Submit a copy of the software licensing files.

PART 2 PRODUCTS

2.1 DESCRIPTION OF THE WORK

A. The following is a summary of the scope of work for this project, with descriptive details of unique aspects of the project. See the remainder of this specification for other more detailed requirements.

1. Equipment / Zone Controllers: New BTL-listed B-BC, B-AAC, and B-ASC Controllers and related Devices shall be provided. The new controllers shall:

    a. Communicate via BACnet/IP with the Router.

    b. Be independent stand-alone Devices capable of executing all functions and sequences upon failure of the building controller or loss of network communication.

    c. Have real-time clocks for scheduling, alarming, and trending functions programmed into the Devices. These functions shall not be performed by a separate device.

    d. Be programmed with all alarms, including fault detection and alarm suppression logic, and issue alarm messages to the Operator Interface via the Router.

    e. Compile and store a minimum amount of trend data locally in the controller.

2. System / Building Controller / Router: A new BTL-listed B-BC System Controller/Router shall be provided. The Router shall communicate with the Operator Interface.

3. Operator Interface: Rack mounted hardware located in the main MDF room shall be provided for the operator interface and data storage requirements of this project. Confirm and coordinate minimum server requirements, location, setup, and installation with the Owner's IT staff.

4. IP Communications: New IP communications wiring/devices shall be provided by the contractor and not connected directly or indirectly to the Owner’s IT Network (except via the IP drop used for the System Controller).

B. Provide control devices, instrumentation, software, and hardware as needed for installation of a new building automation system (BAS) comprised of direct digital controls. Check-out, programming, functional testing, commissioning, training, and warranty service of the same.

C. Provide all labor, materials, equipment, and services necessary and incidental for a complete Building Automation System (BAS) comprised of various types of BACnet BTL-listed products (B-BC, B-AAC, and B-ASC Direct Digital Control (DDC) Controllers, B-RTR Routers, B-AWS Operator Interface, electronic actuation, conventional electric/electronic controls, and equipment-mounted controls. Include all software and hardware for all specified capabilities. No B-SA or B-SS Controllers are permitted.

D. Provide pre-construction and as-built submittal documentation that shows all BAS equipment. Submit graphic screen shots for Owner's prior review. Provide testing for system acceptance, owner operator training, and warranty services as described.

E. Incorporate hardware resources sufficient to meet the functional requirements of these specifications. Include all items, not specifically itemized herein, that are necessary to implement, maintain, and operate the system in compliance with the functional intent.

F. Provide all hardware licensing fees, annual software maintenance, security patches, firmware upgrades, etc, including installation labor, up to the date of substantial completion, at no additional cost to the Owner.

1. Applies to all DDC Controllers and the Operator Interface.
2. Applies to all minor and major revisions and/or version upgrades to software.

2.2 RELATED WORK

A. Items supplied under this section that are specified for installation under other mechanical specification sections may include but are not limited to: dampers, valves, flow switches, flow sensors, thermal wells, pressure taps, etc. This contractor will be responsible for proper installation and operation of the devices.

B. Items specified under other mechanical sections that are part of, integrated with, or installed under this section may include but are not limited to: plant controls, equipment controls, auxiliary devices, factory sensors, safeties, relays, interface cards, variable speed drives, etc. See the associated specification sections for more information.

C. Power: All power for the BAS shall be independently circuited (not on with any other building or equipment circuits). See the electrical drawings for locations of 120V power available. Any additional power required, or power required in different locations, shall be provided under this section, and installed in compliance with requirements of the electrical specifications.

D. Ethernet/IP: All Ethernet/IP communications wiring and switches for the BAS shall be provided under this section, installed in accordance with the IT specifications. See the electrical drawings for locations of the building's intra/internet connection for the BAS system.

E. Wiring Requirements: Install wiring, boxes, and raceway in accordance with NEMA standards. Provide all components, fittings, supports, and accessories for a complete raceway system. All wiring shall be routed in appropriate raceway, approved for the application. Power wiring shall be separated from communications wiring.

F. Fire Alarm System: Duct smoke detectors and/or fire alarm fan shutdown modules, and other fire alarm-controls (fire/smoke dampers), are by the electrical contractor. This contractor shall confirm all life safety interlocks to motor starters, variable frequency controllers, or other devices are installed and operating properly with the BAS.

G. Test and Balance: Provide assistance to the efforts specified in the testing and balancing specification. This assistance shall include on-site instruction on operator interface to the BAS, the provision of software and any special hardware to allow operator interface, and instruction on access to all setpoints or parameters that need to be adjusted for balancing.

H. Thermostats: Install/wire all thermostats provided with equipment specified in other mechanical specification sections at the locations shown.

2.3 ARCHITECTURE AND GENERAL REQUIREMENTS

A. BAS installations shall be comprised of equipment, data, and data communications that implement BACnet as the primary means of communication, and are fully compliant with ANSI/ASHRAE Standard 135, “BACnet”, and these specifications. The term “DDC Controllers”

within this specification, collectively refers to the “System Controller”, “Equipment Controller”, and “Zone Controller” product types as defined and specified herein.

B. Communications between DDC Controllers (and with/between BACnet Routers and the Operator Interface) shall be via BACnet/IP.

   1. All System Controllers, BACnet Routers, and Operator Interface hardware shall be connected together by the "System Network" using BACnet-IP communications.

   2. All Equipment Controllers and Zone Controllers shall be connected to System Controllers or BACnet Routers via “Controller Networks” using BACnet/IP communications.

   3. Proprietary communications between DDC Controllers, BACnet Routers, and/or Operator Interface software of a given manufacturer shall not be used.

   4. All DDC Controllers shall be connected by a BACnet network (ie, using BACnet communications).

      a. Home run or star topology: Equipment controllers serving plant equipment and air handlers shall be directly connected to the BACnet-IP network at the nearest switch / patch panel location.

      b. Daisy chain topology: Zone controllers serving terminal equipment and fan coil units may be daisy chain connected via a BACnet-IP subnet, only if all controllers include a communications failover switch.

      c. Ring type topology: Zone controllers serving terminal equipment and fan coil units may be connected in a ring or loop topology only where using an RSTP-capable switch allowing link failover recovery.

      d. The system architecture shall be planned such that any single controller failure will not result in a loss of communications to any other controllers. The architecture need not be planned for loss of communication due to cut wires.

      e. The system architecture shall be planned such that all equipment designated on emergency power will have controls independently circuited and also connected to emergency power.

      f. The system architecture shall be able to accommodate integration to third party controls via MS/TP, MODBUS, etc, if required for the project.

      g. All air terminal unit controllers shall be connected to the same network switch as the associated air handler, unless otherwise approved.

      h. Cable type shall be Cat-6 or better. Cable length between controllers shall be limited to 50-m (165-ft). Cable color shall shall be purple or grey.

   5. The contractor shall consult with the owner's IT staff prior to submitting system architecture diagrams for review.

C. A sufficient number of System Controllers or BACnet Routers with Controller Network connections shall be provided to support the number of Equipment/Zone Controllers.

   1. No more than 50 devices or 50% of the manufacturer’s recommended maximum (whichever is less) shall be connected to each network.

2. Note that if a DDC Controller or BACnet Router has more than one Controller network (ie, more than one Controller Network port), each network shall be treated as if it were a separate network.

D. A sufficient number of DDC Controllers and Point Expansion Modules shall be provided to meet the point needs of the project.

1. A Point Expansion Module provides slaved control (does not execute its own control software) via serial or multi-drop communications connection (EIA-485, ARCNET, MS/TP, etc) from a DDC Controller.

2. A Point Expansion module provides slaved control (does not execute its own control software), and shall be installed within the same enclosure as the DDC Controller it serves.

3. Point termination types shall include:

a. Analog Input (AI): Thermistor, 0-10 VDC or 4-20 mADC.

b. Analog Output (AO): 0-10 VDC, 0-20 VDC or 4-20 mADC.

c. Binary Input (BI): Dry contacts, including contact closure “pulses” up to 10 per second.

d. Binary Output (BO): Two-state DC voltage signal or magnetically held dry contact closure.

E. Each DDC Controller shall be provided with sufficient memory to meet the needs of the programming, alarming, and trending requirements of each device, with 25% spare capacity for future use.

F. Each DDC Controller shall provide spare additional I/O such that future use of spare capacity shall require providing only the field device, field wiring, point database definition, and operational sequence programming changes as required. Additional point modules may be required to implement use of these spare points.

1. Provide at least one (1) spare universal input and one (1) spare universal output, or 15% spare universal I/O of the total capacity of each DDC Controller, whichever is greater.

2. If I/O is not universal then provide at least one (1) spare analog input, one (1) spare digital input, one (1) spare analog output, and one (1) spare digital output, or 15% spare I/O of the total capacity for each point type, whichever is greater.

G. Each DDC Controller shall have a spare communications port (eg, not used for network communications purposes) for local connection of a portable Operator Interface:

1. IP-Communicating DDC Controllers: Ethernet RJ-45 connection. Devices not equipped with an additional integral IP port shall include a separate, functional/powered network switch in the control panel.

2. MS/TP Communicating DDC Controllers: USB connection, with proprietary cable provided for connection to the controller if needed.

H. Each Central Plant and Air Handler shall be controlled by its own dedicated DDC Controller. A single DDC Controller shall not be used to control more than one Plant or more than one AHU, nor shall more than one DDC Controller be used to control a single Plant or single AHU. Furthermore, all points associated with the Sequence for a given Plant or AHU shall be connected to that equipment's DDC Controller.

1. A Point Expansion module is not considered a DDC Controller within this specification and therefore can be used for point expansion to meet the above requirement.
2. A point shared by multiple DDC Controllers (eg, outside air temperature) need not be wired to each of the associated DDC Controllers.

I. Zone Controllers that use BACnet/IP communications shall be connected to the same network switch as the upstream Equipment Controller (ie, the BAS architecture shall connect air terminal units, reheat coils, etc to the same network switch as the multiple zone AHU Equipment Controller for that area).

J. Each DDC Controller shall continue to execute its control software, sample input points, update output points, and perform the Sequence of Operations without connection to the BACnet/IP Network, Controller Network, or an Operator Interface.

K. All DDC Controllers shall utilize non-volatile or battery-backed volatile memory for writable information (eg, setpoints and other control parameters, custom control software, and the device's control state at power loss). Battery backup for volatile memory shall provide for at least 72-hours of power loss.

1. Each DDC Controller shall be able to detect a changeover to battery-backed power and modify the state of the control program, if required by the sequence of operation.
2. Upon the reestablishment of power to a DDC Controller each device shall return to normal operation (eg, network communications, scanning of inputs, execution of the sequence of operation, and control of the outputs) in less than one minute.
3. If this requirement cannot be met the Contractor shall provide 24-hours of uninterruptible power supply to each DDC Controller so that they are not affected by a loss of power in the building (and the sequence of operation shall be modified accordingly so that nuisance alarms do not occur during a loss of building power).

L. Furnish and install any power supply surge protection, filters, etc as necessary for proper operation and protection of all controllers, operator interfaces, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations of 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

M. Communications wiring/cable shall meet the requirements of the manufacturer (ie, BAS and/or Third-Party Controls) and that of the communications standard (ie, IP, MS/TP Modbus RTU/485, etc.). Communications routers, switches, repeaters, etc shall be provided according to the topology requirements of the communications technologies.

N. Digital Communications to Third-Party Controls:

1. The BAS is required to send/receive information via communications data link protocols (eg, Ethernet) and application protocols (eg, BACnet) to Third-Party controls (eg, boiler, chiller controllers).
2. Investigate the equipment for the type of communications technology/interface and application protocol used by each of the Third-Party controls, and for the list of data to be shared with these controls.
3. A Third-Party controller’s communications shall be connected:

a. Directly to the DDC Controller associated with the controlled equipment (ie, a boiler's factory controls connected to the DDC Controller that's controlling the heating plant).

b. To the same physical MS/TP network or BACnet/IP subnet as the DDC Controller associated with the controlled equipment (via data link router and/or gateway if needed).

c. To the same System Controller or BACnet Router to which the DDC Controller associated with the controlled equipment is connected.

4. Controls that use a BACnet MS/TP interface shall connect with the Controller Network via BACnet MS/TP-to-IP routers.

5. Communications not requiring a Gateway (eg BACnet): Design the BAS to include the specific DDC Controllers or BACnet Routers that include the necessary data link layer interfaces (ie, MS/TP) for the Third-Party controls.

6. Communications requiring a Gateway (eg Modbus) and Interface (eg, EIA-485): Provide gateway software (eg, a Modbus "driver"), and a connection (eg, RS-485) to which the DDC Router/Panel associated with the Third-Party system will be terminated.

2.4 DDC CONTROLLER REQUIREMENTS

A. The BAS shall be comprised of BACnet-listed B-BC, B-AAC, and B-ASC Controllers only ("DDC Controllers" shall herein refer to "System Controllers", "Equipment Controllers" and "Zone Controllers" as defined later in this specification).

1. No B-SA or B-SS listed devices are permitted to be used as "DDC Controllers".

2. The exclusive use of only either B-BC, B-AAC, or B-ASC Controllers is allowed subject to specific requirements for each of these cases outlined below.

B. All DDC Controllers shall be provided with the following features which shall be set up and used for this project:

1. Real-Time Clock: Battery or capacitor backed up for power losses per the above "Architecture" requirements. For use in the below features and in any pre-programmed or custom-programmed sequences that use time clock, calendar, and scheduling information.

2. Start/Stop Scheduling: The start/stop scheduling required by the sequence of operation shall be stored within the controller and viewable/editable via the Operator Interface.

3. Alarming: The alarming required by the sequence of operation (or general alarming requirements in this section) shall be based on alarm logic programmed into the controller via the software editor. The controller shall communicate alarm messages to the Operator Interface and shall also store all alarms that have occurred in the preceding 24-hrs minimum (eg, so that the Operator Interface can retrieve alarms that it may not have received due to a loss of communications).

4. Trending: The trend logs required by the sequence of operation (or general trending requirements in this section) shall be set up within the controllers. Trend log storage capabilities shall be for a minimum of 24-hrs (at 5-min intervals) per physical point. Trend data shall be sampled and stored at the controller, archived to the hard disk for storage, and retrieved for use in charts and spreadsheets or for viewing from the Operator Interface.

5. Custom Programming: Controllers shall be programmable via the Operator Interface's Custom Programming editor (see the Operator Interface Software requirements).

2.5 BACNET ROUTER

A. A BACnet Router is a BTL-listed BACnet B-RTR device with the BACnet options specified below, including non-volatile memory for operating system software; read/write memory for routing/BBMD setup information; real-time clock, and communications support for all DDC Controller types.

B. System Network: Provide 10baseT Ethernet communications for interconnection to other BACnet Routers, System Controllers, Operator Interfaces, and to an Internet/Intranet connection.

C. Routing: Provide BACnet Clause 6 Routing (between the BACnet Router and its Controller Network connections) and BACnet/IP Broadcast Management (BBMD).

D. Controller Network: The BACnet Router shall be a Master to one or more BACnet IP data link layer communications connection for Equipment and Zone Controllers.

2.6 SYSTEM CONTROLLER

A. A System Controller is a BTL-listed BACnet B-BC device with the BACnet options specified below, including non-volatile memory for operating system software; read/write memory for custom control software programming, trending, scheduling, and alarming; real time clock; and communication support for all DDC Controller types.

B. System Network: Provide 10baseT Ethernet communications using the BACnet/IP data link layer for interconnection to other DDC Controllers, Operator Interfaces, and to an Internet/Intranet connection.

C. Routing: Provide BACnet Clause 6 Routing (between the System Controller and its Controller Network connections) and BACnet/IP Broadcast Management (BBMD).

D. Controller Network: The System Controller shall be a Master to one or more BACnet IP data link layer communications connection for Equipment and Zone Controllers.

1. One or more other EIA-485 communication port types may still be required to connect to Third-Party controls.)

E. Optional Point Termination: System Controllers may be utilized for direct point termination through either integral point connections or point expansion.

1. Point expansion shall communicate with the System Controller via the Controller's microprocessor bus (ie, they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).

2. Note: A "Point Expansion Module" as defined below does not meet the point expansion requirements defined herein for a System Controller.

2.7 EQUIPMENT CONTROLLER

A. An Equipment Controller is a BTL-listed BACnet B-BC or B-AAC device with non-volatile memory for operating system software; read/write memory for custom control software

programming; trending, scheduling, and alarming; real-time clock; and communications support for a local Operator Interface and the Controller Network.

B. Controller Network: Each Equipment controller shall have a BACnet/IP communications connection/port. Equipment controllers may also require an EIA-485 port to connect to Third-Party controls.

C. Point Termination: Equipment Controllers shall provide direct point termination through integral point connections and/or point expansion.

1. Binary outputs shall include manual three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation. Alternatively, this feature may be provided thru an LCD interface.

2. Point expansion shall communicate with the Equipment Controller via the Controller's microprocessor bus (ie, they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).

2.8 ZONE CONTROLLER

A. A Zone Controller is designed for specific zone control or packaged equipment applications (ie, “Application Specific”), with limited point capacity/type capabilities, and application-specific options (eg, integral actuator & DP sensor for VAV box control). It shall meet the requirements of an Equipment Controller with the variances listed below.

B. Terminal Unit Zone Controllers shall provide pressure independent control via an integral differential pressure sensor for airflow measurement and an optionally integral damper actuator.

C. Terminal Unit Zone Controllers shall include a minimum 10-bit A/D converter resolution with a minimum published sensor range of 0.005-inch water column.

D. Each Zone Controller shall be provided with integral point termination. Additional point capacity/types may be provided by optional point expansion or Pont Expansion Modules.

E. Combination room sensor / controllers are not permitted without written approval.

2.9 COMMUNICATING ZONE SENSORS

A. Surface-mounted communicating zone sensors consisting of sensing elements in a ventilated cover with an integral local access port.

1. Where indicated, sensors shall include setpoint adjustment, temperature indication, and occupancy override button. Include sensing options as noted in sequences or indicated on the drawings. Program for adjustment in whole degrees or half-degrees (no tenths).

2. Sensors located in entryways, corridors, restrooms, or other locations shall be thermally bonded to the back of a flush-mounted stainless-steel cover plate. With approval from the engineer, sensors may also be network type without display or setpoint adjustment.

3. Combination room sensor / controllers are not permitted without written approval from the engineer. Where permitted, all other zone sensor types shall be of the same design, having the same or similar interface.

B. Where zones have multiple sensor functions indicated, provide a single manufacturer's series of all-in-one zone sensors with the capabilities listed.

C. Insulated Base: Provide insulated mounting base where necessary due to structural cavities, masonry walls, proximity to exterior openings, and uninsulated spaces, preventing temperature of mounting substrate from affecting sensor performance.

D. Guards: Provide impact resistant, transparent, ventilated, locking guards to protect sensors from damage in all public areas such as entryways, restrooms, corridors, or as indicated on the drawings. Bapi-Guard BG2 low-profile polycarbonate, or equivalent.

2.10 PANELS AND ENCLOSURES

A. Controllers, instruments, and other accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated.

B. Controls components not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures.

C. Provide heaters within enclosures as needed to protect controllers and other devices to -30ºF ambient. Provide power to the same.

D. Provide NEMA Type 1 enclosures for dry indoor locations. Provide NEMA Type 4 enclosures for outdoor locations or indoor locations where water damage is possible. Provide NEMA Type 4 enclosures in all mechanical spaces.

2.11 OPERATOR INTERFACE SOFTWARE

A. General Requirements: The Operator Interface web server shall reside on a high-speed network with System Controllers. The system shall support Thin Client access, with a minimum of 5 simultaneous clients using a standard internet web browser to perform all of the capabilities described herein. Operator Workstation software shall be BTL-listed, conforming to the BACnet Advanced Workstation (B-AWS) device profile (as specified in ASHRAE 135, BACnet Annex L).

B. System Software:

1. System Graphics: The system shall provide display of custom graphic screens with dynamic point information and the ability to show animation by shifting image properties based on the status of the point. The terms "graphic screens" and "graphics" in this specification refer to graphical images viewed via a web browser (Thin Client).

2. Graphics Generation: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The package shall be a graphically based system to create and modify graphics that are saved in industry standard formats. The package shall also provide the capability of capturing or converting graphics from other programs.

3. Vector Graphics: All graphic screens shall be configured with scalable vector graphics technology, using a responsive design that automatically adjusts resolution to the browser using it, viewable without the need for horizontal scrolling, and tested at several current popular device/screen resolutions. Graphics shall be optimized for mobile support and responsive to the device type.

4. Graphics Library: Furnish a complete library of standard system graphics, such as boilers, chillers, air handlers, terminal units, fan coils, and unit ventilators. The library shall also include standard component symbols for other equipment, including fans, pumps, coils, valves, piping, dampers, ductwork, etc. The library shall be in a file format compatible with the graphics generation package.

C. System Applications:

1. Automatic System Database Save and Restore: Each workstation or web server shall store on the hard drive a copy of the current database of each DDC Controller. The database shall be automatically updated whenever a change is made in any DDC Controller.
2. Manual System Database Save and Restore: A system operator with proper password clearance shall be able to save the database from any DDC Controller. The operator shall also be able to clear a DDC Controller's database and manually initiate a download of a specified database to any panel in the system.
3. System Configuration: Provide an application for BAS configuration of the system (DDC Controller communications addressing, point definition, etc), allowing for future system changes or additions by users under proper password protection.
4. Online Help: Provide a context-sensitive, online help system to assist in operation of the BAS. Online help shall be available for all applications and shall provide the relevant data for that particular screen.
5. System Diagnostics: The system shall automatically monitor the operation of all DDC Devices including network communications and provide an alarm when a failure occurs.

D. Security Features:

1. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data.
2. Operator Access: The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator.
    a. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
    b. Users with system administrator rights shall also be able to vary and deny each operator’s privileges based on the geographic location.
    c. Example: The ability to edit operating parameters in Bldg A, to view but not edit parameters in Bldg B, and to not view or edit in Bldg C.
3. Password Policy Rules: The system administrator shall be able to invoke policies for minimum password strength, including number of characters, special characters and numbers, upper and lower case, etc.
4. Automatic Log Out: Automatically log out each operator if no keyboard or mouse activity is detected. The auto logoff time shall be user adjustable.
5. Encrypted Security Data: Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. Audit and Security Detail: All users accessing the system shall have their actions recorded. Information recorded shall include: login/logout time and date; system modifications (with

before and after values); ability to report user activity based on individual and/or date and time.

E. Standard Operating Features:

1. Point/Data Overrides/Modifications: Output points and system data (ie, setpoints) shall be modifiable (ie, auto vs. manual and overridden value) via a link to each item's graphic screen image.

2. Alarm Processing: An alarm log with acknowledgement and alarm clearing functions; and the ability to configure alarm limits, priority levels, and system reactions (eg, email, text message, dial-out, etc.). Alarms shall use BACnet Alarm and Event Services.

3. Scheduling: A graphical method for scheduling equipment operation including normal, weekend, holiday, and exception scheduling. Scheduling shall use BACnet Calendar and Schedule Objects.

4. Trend Logs: The ability to define and view custom historical trend logs for any data object in the system, both stored and archived. The data may be displayed in tabular or graphical formats. Trends shall use BACnet Trend Objects.

5. Trend Graphs: Software shall be capable of creating custom two-axis graphs relative to time that display up to twelve concurrent object types using unique colors.

    a. Any system point may be trended at time-based intervals or change-of-value, both user definable.

    b. Operators shall be able to create custom trend graphs for all physical points, virtual points, and/or calculated variables.

    c. Operators shall be able to edit graph configuration to display a specific time period or data range.

    d. Setup and viewing may be accessed directly from any graphics on which the object is displayed.

    e. Where campus systems are in use, trend point data logs shall be separated by building.

F. Control Software Editors:

1. Controllers: A full screen graphical editor for each type of application that allows the operator to view and change the configuration, parameters, and setpoints for all controllers.

2. Custom Programming: A graphical editor for creating, modifying, and debugging the custom control programming and database management functions for all DDC Controllers.

3. Install the software on the Web Server for use via a Thin Client PC or provide the software with licensing for use on up to two portable operators terminals.

4. Custom programming language shall include if/then/else logic, Boolean logic operators (eg, or, and, etc), math operators (eg, plus, minus, multiplied by, divided by, powers, roots, etc), math comparison operators (eg, =, >, <, =>, etc), count down/up timers, access to time clock and scheduling information, access to input point values, the ability to modify output point values/states, access to alarm information (including those built-in for controller health and/or communications monitoring), access to trend log information, access to data

in other controllers, built-in HVAC control functions (eg, PID, optimum start, thermostatic on/off control, psychrometric calculations, deadband, high/low selector, etc), etc.

G. Other Requirements:

1. Third-Party Software: Provide any other software needed for the operation of the Operator Interface software, such as Microsoft SQL or.NET, Visio, Excel, etc.

2. Java Web Applets: Systems that use Java web applets are not permitted. Only native browser-based user interfaces (HTML5 only) that do not require Thin Client plug-ins are acceptable.

H. Software Maintenance: All Operator Interface software and programming tools shall be updated to the most current version and all licenses shall be renewed to the level specified herein, at the completion of the project.

2.12 OPERATOR INTERFACE HARDWARE

A. Provide hardware to meet or exceed the BAS manufacturer’s minimum recommended specifications with sufficient memory to store all project programming, alarming, trending, workstation software, and database storage, plus an additional 50% capacity.

B. The specifications indicated below shall be the minimum provided. Expanded hardware capabilities (faster processor, larger hard drive, etc.) shall be provided based on the BAS manufacturer's Operator Interface requirements.

C. Minimum trend data storage capabilities shall include all points identified in the sequence of operations, at change-of-value or minimum intervals (or as required to capture the full range of activity) for at least two years, unless noted otherwise.

D. Web Server PC: A dedicated operator workstation and web server (B-AWS) shall be used to meet the programming and data storage requirements stated herein. New hardware shall be provided to meet the following minimum specifications:

1. Rack-mounted Microsoft Windows based PC.

2. Windows 10/11 Enterprise x64 with MS Edge web-browser.

3. 2.8GHz Xeon Silver processor, 32GB RAM, 512GB SSD hard drives.

4. HD graphics, DVD+/-RW optical drive, 10/100/1000 MHz Ethernet card.

5. 22-inch color monitor, USB standard keyboard, two button optical mouse.

6. 750VA UPS battery backup, USB and Serial 120VAC (where none exists).

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Install components in accordance with manufacturer's instructions. Where the drawings are in conflict with these instructions, the contractor shall submit a written request for clarification prior to beginning the work.

B. All control components shall be installed within enclosures. Enclosures for all devices except space sensors shall be NEMA rated for the location.

C. Electrical installation shall comply with requirements of the National Electric Code, the authority having jurisdiction, and applicable sections of these specifications.

D. The contractor shall review the scope of work of other trades and coordinate installation to avoid field conflicts.

E. All controls installation shall be the responsibility of this contractor, regardless of where shown (or not shown) on the drawings.

3.2 POWER SOURCE

A. Power for all enclosures and equipment, including branch circuit wiring from breaker panels, shall be the responsibility of this contractor, installed in compliance with requirements of the electrical specifications.

B. All power source wiring is new; see the electrical drawings for panel locations. Where additional wiring is needed, this contractor shall extend new power source wiring for operation of all equipment and devices provided under this section.

C. General requirements for obtaining power include the following:

1. Obtain power from the electrically most proximate power panel.
2. Obtain power from emergency power circuits where available.
3. Connect to a dedicated breaker designated for use by the BAS only.
4. Provide and install wire/breakers of the proper size per NEC.
5. Do not obtain control power from equipment circuits.

D. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers, power wiring, and raceways. Comply with applicable sections herein.

E. Furnish and install any power supply surge protection, filters, etc, as necessary for proper operation and protection of all controllers, operator interfaces, and other hardware and interface devices.

F. DDC Controllers and devices connected to and/or responsible for system critical equipment shall be protected by an uninterrupted power supply (UPS) with surge suppression and battery backup. For this project, systems include:

1. Operator Interface and System Controller / Router.
2. Air Handler, Heating Plant, and Chiller Plant Controllers.

3.3 CONTROL WIRING

A. All control wiring is new. Provide the following as work of this section, complying with the electrical specifications where applicable.

1. Control wiring between field installed components, indicating devices, and unit control panels.

2. Interlock wiring between electrical devices and sensors, and between motor starters or variable frequency controllers for mechanical equipment and controls.
3. Wiring associated with third party controls, remote indicating and alarm panels, and connections to associated field devices.
4. Safety interlock wiring at plant equipment (boilers, chillers), gas-fired appliances, smoke detector, etc. See the applicable submittals for more information.
5. All other wiring necessary for a fully complete and functional control system.

B. Install control wiring within electrical metallic tubing (EMT) in exposed locations or concealed inaccessible locations, and within fan rooms, pump rooms, and other mechanical rooms.

C. Flexible metal cable (FMC), not in excess of three feet in length, shall be used for termination of raceway on vibrating equipment. The flexible metal raceway shall be supported at each end.

D. UL plenum rated cable is acceptable for concealed, accessible locations, ceiling plenums, and crawl spaces only.

E. Field devices provided with pig-tail wiring shall be enclosed with a suitable means to allow for flexible metal raceway attachment.

F. Install parallel to building lines, plumb and level, rigidly supported from structural members. Install back-boxes with EMT for all wall-mounted devices.

G. Raceway supported from or anchored to piping, duct supports, the ceiling suspension system, or other electrical conduits is not acceptable.

H. Shielded wiring shall be used where recommended by the manufacturer and installed according to the manufacturer's installations.

I. All controller level communications wiring shall be installed as continuous lengths with no splices between termination points.

J. Do not bend wiring or cable at a radius less than the manufacturer’s recommended bend radius. Do not exceed the recommended cable pull tension. Do not over-cinch or crush cables.

K. Ethernet/IP communications wiring and other devices needed to support the BAS (eg, switches) shall be provided by this contractor and shall comply with the requirements of the electrical specifications.

L. Structured cable installation pathways shall be kept 48-inches from motors, generators, frequency converters, transformers, and uninterruptible power systems, 12-inches from power conduits, cables, and panel boards, 6-inches from flues, hot water piping, and steam lines, and 6-inches from fluorescent and high frequency lighting.

M. Wiring to space sensors may be installed within metallic surface mounted raceway (wire-mold), only if all other options have been exhausted first. The use of surface mounted raceway is not permitted without written approval from the engineer.

3.4 WALL MOUNTED SENSORS

A. Install electrical boxes with a faceplate to match the sensor cover if the sensor cover does not completely cover the electrical box.

B. In finished areas, install recessed electrical boxes within walls. In unfinished areas, electrical boxes may be surface mounted.

C. Align electrical boxes with other electrical devices such as visual alarms and light switches. Where possible, align in both horizontal and vertical axis.

D. Install protective guards where wall sensors are mounted in public areas subjected to damage or where mounted in public areas with adjustable setpoints.

3.5 THIRD PARTY CONTROLS

A. Third-Party controls are typically provided under other sections of this specification (or may be specified under this section but not manufactured by the BAS supplier). See applicable equipment specifications and instructions for installation and configuration requirements.

B. If a BAS interface does not support BACnet Alarm and Event services, the BAS shall regularly poll (ReadProperty service requests) the interface for the shared data. Alarm and run status data shall be polled approx every 10-sec, while other operating data may be polled approx every 1-min.

C. Multiple interface alternatives may be available from the equipment manufacturers. Where an alternate BAS Interface is available and desired, this contractor will be responsible for coordinating the correct purchase with the supplier, at no additional cost to the project.

D. Provide field wiring for all third party controls and safeties where applicable. See equipment schedules and specifications, and confirm with the manufacturer's submittals. Wiring may include, but is not limited to:

1. Wiring for boiler and chiller operatring controls and safeties (e.g. flow switch, low water cutoff, high/low gas pressure).
2. Cascade communication wiring between modular source equipment (e.g. boilers, chillers, heat pumps, etc).
3. Interlock wiring between equipment and related variable speed pump (e.g. start/stop, speed output, etc).
4. Interlock wiring for all auxiliary equipment and devices (e.g. combustion air dampers, vent draft sequencers, etc).

E. Heating Plant Controls:

1. The interface shall be hard-wired (point-to-point wiring to applicable terminations on the interface board) for external interlock, firing rate signal, and all-points alarm output of each boiler.
2. Digital communications via a BAS controller shall be used to gather all other specified or available information. Install RS-485 communications wiring (Modbus or BACnet MS/TP) from the BAS to each boiler per the equipment manufacturer's instructions.
3. All setup and configuration of the boiler controllers shall be by a manufacturer’s trained technician.
4. Heating Plant Field Wiring:
    a. Install cascade wiring between each boiler (where applicable).

b. Install interlock wiring between each boiler and its related variable speed pump.

c. Install wiring for all safeties (low water cutoff, flow switch, high/low gas pressure).

F. Chiller Plant Controls:

1. The interface shall be hard-wired (point-to-point wiring to applicable terminations on the interface board of the chiller) for start/stop interlock, chilled water temperature reset, and manufacturer's general fault condition.

2. Digital communications via a BAS controller shall be used to gather all other specified or available information. Modbus RS-485 or BACnet IP communications wiring shall be installed from the BAS to the chiller and shall be connected per the equipment manufacturer's instructions.

3. All setup and configuration of the chiller controls shall be by a manufacturer's trained technician.

G. Computer Room Air Conditioners:

1. The computer room air conditioners are supplied with integrated operating and safety controls, and a master/slave controller. No hard-wired control interface is required. The BAS will monitor operation via a network connection.

2. Digital communications via a BAS controller shall be used to gather all specified or available information. BACnet MS/TP communications wiring shall be installed from the BAS to each unit per the equipment manufacturer's instructions.

3.6 PANELS AND ENCLOSURES

A. All control components, including controllers, sensors and other devices, shall be installed within enclosures. Enclosures for all devices except space sensors shall be NEMA rated for the location.

B. Provide each enclosure with a properly sized line filter, electrical disconnect, control fuse, and transformer.

C. Enclosure locations shall be coordinated with other trades and shown in the submittals for approval.

D. Freestanding enclosures shall be supported with channel iron frames, securely anchored to the structure and rigidly braced.

E. Provide a minimum of 36-inches working clearance in front of all enclosures. The enclosure door shall open at least 90-degrees from a closed position.

F. Enclosures serving terminal equipment may be mounted above the ceilings at or near the equipment. All other enclosures shall be mounted in accessible service spaces with mounting heights at a maximum of 78-inches to the top of the enclosure.

3.7 IDENTIFICATION

A. All system components, including controllers, sensors, and other devices, shall be identified with nameplate designations to match the shop drawings.

B. All wiring and cabling shall be identified at each point of termination using a printed tag to match that shown on the drawings and affixed using a heat shrink sleeve.

C. Components mounted within enclosures shall be identified with adhesive backed metalized polyester film labels with printed designations.

D. Attach laminated control panel wiring schematics inside the door of each control enclosure. Schematics shall indicate all controllers and devices installed within.

E. Provide self-adhesive vinyl ceiling grid tags (black text on white background) to locate valves, dampers, control devices, and other concealed equipment above ceiling panels.

F. Enclosures and other devices mounted in the field shall be identified with engraved black plastic laminate labels with white lettering and adhesive backing or screws.

3.8 ADDRESSING

A. Address Assignments: Facility addressing schemes shall be provided by and/or coordinated with the Owner's IT department prior to beginning device configuration. Absent specific addressing from the Owner, the contractor shall submit alternative schemes for review and approval.

B. Network Numbering: BACnet allows 65,535 network numbers per BACnet internetwork. Addressing for unique network numbers shall be coordinated with the Owner's IT department prior to implementing a network numbering scheme.

C. Device Instance Numbers: BACnet allows 4,194,305 device instances per BACnet internetwork. Addressing for unique device instances shall be coordinated with the Owner's IT department prior to implementing device instance numbers.

D. Broadcast Management: No BACnet Broadcast Management Device (BBMD) capability shall be enabled within the scope of this project.

E. Object Naming Convention:

1. A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across the Owner's network. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible.

2. Names are to be uniquely descriptive of the associated equipment, device, or software point. Descriptions are to be prefixed with the Owner's building reference, followed by the component type, and point description.

3. An object name legend fully describing all the descriptor abbreviations shall be provided to the owner at the completion of the project. The legend shall be accessible from the Operator Interface graphics.

3.9 PROGRAMMING

A. All database entry, software configuration, initialization of trends and alarms, and custom application programming to meet this specification shall be provided. The contractor will consult with the Owner to confirm setpoints and configuration parameters stated herein.

B. All setpoints, schedules, tuning parameters, control dead-bands, operating differentials, reset schedules, etc shall be adjustable by an operator from the user interface without the need for accessing and modifying custom control programming code.

C. User views, graphic layouts, point names, schedules, alarm categories, alarm notifications, space temperature setpoints, adjustment ranges, dead-bands, etc shall be configured to meet the approval of the Owner (even if specified differently herein).

D. Trend logs (trended points, frequency, and number of samples) and alarmed points (alarm limits, alarm messages, message destination, and transmission formats) shall be set up to meet the approval of the Owner (even if specified differently herein).

E. Failure to meet with the Owner and come to agreement prior to device configuration may require the contractor to make changes to the above listed items at the Owner's request. Changes will be made at no additional cost to the project.

F. Source Optimization: Automatically perform source optimization for all distribution and plant equipment in response to needs of downstream equipment, by increasing or decreasing setpoints in response to requests from downstream loads.

   1. Transfer demand from zone controllers to distribution equipment controllers and from distribution systems to heating and cooling plant controllers.

   2. Automatically detect those zones or systems that may be excessively driving the reset logic and generate an alarm or other indication.

   3. Readily allow operator removal of zones from the reset algorithm.

G. PID Control: Provide direct and reverse-acting proportional + integral + derivative algorithms. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

   1. Each algorithm logic function shall include anti-windup, ramp step, and selectable controlled variable, setpoint, and gains.

   2. The calculation interval, gains, ramp step, and other tuning parameters shall be adjustable by an operator with appropriate security access.

H. Zone Setpoints: Each thermal zone shall have operator definable, independent occupied and unoccupied heating and cooling temperature setpoints, separated by a deadband. Only one setpoint shall be active at any time.

I. Point Override: Each displayed point shall allow mouse-driven override from the graphics. Overrides shall occur in the controller and be subject to password privileges. Points that are overridden shall be reported as an alarm and displayed in a coded color on the equipment graphic. A report listing points that are in a current override state shall be available.

J. Hand / Off / Auto: All equipment programs shall include logic for an HOA switch on the equipment graphic. In the "Off" position, the equipment will not run or generate alarms regardless of other logic. In the "Hand" position, the equipment will continue to shut down due to any software or hardware safety that would normally shut down the equipment.

K. Trend Logs: Long-term historical trending for all points on the system shall be configured for commissioning efforts, for testing performance evaluations, and for the owner's long-term diagnostic use. See the Sequence of Operations section for minimum lists of trended points. Trend logs shall be separated by building.

L. Alarm Communications: The BAS shall automatically initiate IP-based communications (email, text messaging, print request to a networked printer) and/or telephone modem dial-out (if applicable) upon selected alarm events. Alarm events shall include a building descriptor.

M. Alarm Suppression: Alarm logic programming shall be set up to avoid generating cascading alarms, mitigating an “alarm storm” event, and reducing the number of nuisance alarms generated by the system. See the Sequence of Operations for more information.

N. Fault Detection Diagnostics: FDD monitoring and alarming capability shall be integral to the programming and reside in the controllers. Overlay software for primary FDD reporting is not an acceptable substitute. See the Sequence of Operations section for more information.

O. Rogue Zones: Provide a method of identifying zones/systems that are excessively driving the reset logic (points, programming logic, and alarms). The intent is to identify zones unnecessarily driving or holding the control loop, preventing reset or energy savings.

P. TAB Coordination: Work with the test and balance contractor to obtain and fine tune all control settings that are determined by balancing procedures. Document control settings from the test and balance contractor, and report any test and balance deficiencies to the engineer. Settings include but are not limited to:

1. Optimum duct static pressure setpoints for variable volume air handlers.
2. Minimum and demand control outside air damper settings for air handlers.
3. Optimum differential pressure setpoints for variable speed pumping.
4. Calibration parameters for air terminal unit boxes.
5. Calibration parameters for flow meters and airflow measuring stations.
6. Variable speed drive output frequency min, max, and design setpoints.

3.10 GRAPHICS

A. Prior to creation of graphics, meet with the Owner (and Engineer) to develop an outline list of the screens to be provided. For each screen, a conceptual layout of the graphics, points/data included, and linkages to other screens shall be submitted for review.

B. Provide custom-developed graphic screens for the controls included in this project. The screens shall include schematic representations of all controlled and/or monitored systems, equipment, points and relevant setpoints/parameters, and floor plans with all space-sensing points represented.

C. All graphic screens are to include date/time and the global outside air temperature (and humidity where specified) displayed in the header in the same location on each page. Where equipment uses a local outside air reference, that value shall also be displayed and labelled in the appropriate location on the equipment graphic.

D. All points on the graphics shall be indicated with clear descriptors, easily understood by day-to-day operators. Short-hand abbreviations or object/point names are not acceptable, unless indicated on the drawings or clearly recognized by the users. Room names and numbers shall be gathered in the field and verified with the Owner prior to implementation.

E. Include a legend link to explain abbreviations and color coding of the graphics and instructions to help the operator with various viewing commands. Explain the intent of changing colors for

alarms, temperatures, loss of comm, and other conditions. The color red is to be reserved for "in-alarm" conditions only.

F. Home Page: The home page shall be visible at system startup and accessible via a link at the top of the navigation tree.

1. The home page shall depict the overall facility, including each floor level and all areas, with thermographic gradient fills displaying zone temperature relative to setpoint for each zone.
2. Provide a list of all air handlers and each central plant, with “normal” (white or green) vs summary “in-alarm” (red) conditions indicated for each.
3. Provide interactive links to each floor level, all areas, individual zones, and indicated equipment.
4. Where applicable for campus systems, a global home page shall include a list of all buildings, including pertinent summary data.

G. Floor Plan Graphics: The intent is to provide floor plan graphics with “at-a-glance” visual color display of current zone temperatures, alarm conditions, and device communication status.

1. All floors in the building shall be represented with one or more graphic screens. Include graphic screens for each mechanical equipment room and a roof plan.
2. Individual floor level pages shall include navigational links to area plans (where applicable), zone level pages, and equipment.
3. If multiple floor plans are necessary to show all areas, provide a graphic building key plan with navigational links to other areas. Use the construction documents as a guide.
4. Floor plans are to include room numbers and descriptions, and accurate locations of space sensors (temperature, humidity, CO2, etc). Confirm all information in the field.
5. Navigational links to the zone controller shall be defined by clicking on the room location. Links to equipment controllers shall be defined by clicking on the equipment designation.
6. Include navigational links to air handlers and plants serving each floor plan area. Indicate "normal" (white or green) or "in-alarm" (red) conditions for each.
7. Dynamic color spectrum display shall be defined for each zone to visually depict zone temperature, occupied condition, and alarm status. The thermograph shall illustrate and automatically intensify gradient fills for each zone, indicating the severity of the temperature deviation.
    a. Zone temperature gradients shall be represented with “warm” colors (yellow, orange) for above-setpoint conditions and “cool” colors (cyan, blue) for below-setpoint conditions.
    b. Zone temperature within the deadband between effective heating and cooling setpoints, shall be represented with green or white for the occupied mode and grey for the unoccupied mode.
    c. The color red shall be reserved for alarm conditions. Red shall not be used for any other indication and no other color shall indicate alarm conditions.

H. Equipment Graphics: All controlled equipment shall have a representative equipment graphic, depicted on an independent page unless otherwise accepted.

1. Equipment locations shall be indicated on the floor/roof plan graphics, with color alarm indication and navigational links to equipment graphics.
2. Equipment graphics at the zone level shall identify room name and number served, and display the equipment designation.
3. Show zone conditions and setpoints. Include outside air conditions and time/date stamp. Override conditions shall be clearly indicated.
4. All analog inputs shall have their corresponding setpoints displayed on the equipment graphics. The user shall be able to override all setpoints.
5. Fans, dampers, pumps, burners, and other equipment shall be rendered as animated objects, displaying the accurate condition, position, etc.
6. Object in alarm condition shall be shown red and signify “alarm” on the graphics for the system, device, and/or point that the alarm is associated.
7. Device communication status, or specifically loss of communication, shall be indicated on all equipment graphics.
8. Program run-state (occupied, unoccupied, heating, cooling, economizing, heat recovery, etc) shall be displayed on all equipment graphics.
9. Links to the cooling and/or heating source shall be on the equipment graphics. Display temperatures and source equipment descriptor.
10. Plant graphics shall schematically show key components of the main system, including multiple boilers/chillers/towers, distribution pumps, control valves, sensors, and all interconnected piping, with navigational links to individual equipment pages as needed.

I. Navigation Pane: Provide an expandable web page navigation tree on the left-hand side of each graphic with short-cut navigational links, in ascending order as follows.

1. Home Page: Top-most entry with navigational link to an overall facility graphic showing each floor plan level and the roof plan (subject to the above requirements).
2. Floor Plans: Entries with navigational links to each floor plan level graphic (and roof plan graphic). Each floor level plan shall be expandable to multiple area plans and/or zone level page links. Each area plan shall be expandable to multiple zone level page links.
    a. Area Plans: Branch entries subordinate to each floor plan page with links to each floor level area plan graphic.
    b. Zone Pages: Branch entries subordinate to each area plan page or floor plan page with links to each zone level equipment graphic.
    c. All entries shall be organized in ascending numerical order based on room number and zone description, with stairwells, entryways, custodial, electrical, mechanical rooms, etc, grouped at the end of each branch.
3. Air Handling Units: Entries with navigational links to each multiple zone and single zone air handling unit equipment graphic. Include entries for each related graphic (exhaust fans, variable speed drive interfaces, etc).
4. Central Plants: Entries with navigational links to each central plant equipment graphic (heating water, chilled water, domestic hot water, etc). Include entries for each sub-system page (boiler, chiller, pump drive interfaces, etc).

5. Outside Air Conditions: Entry with navigational link to outside air conditions (temperature, humidity, CO2, etc). Include current conditions, highs and lows for the day, month, and year, and dates/times of each.
6. Summary Graphics: Entries for each miscellaneous or summary graphic page as applicable for the project.

J. Summary Graphics: Provide graphics in table format to summarize pertinent data/points for items outlined below. Graphic pages shall be accessible from the navigation pane and include navigational links to the pertinent equipment pages. Override conditions shall be clearly indicated.

1. VAV Overview Table: Indicate terminal box mark, room number, and zone description; operating mode, effective heating setpoint, effective cooling setpoint, and space temperature; heating output, damper output, heating demand, and cooling demand; airflow max, min, and reheat conditions, current actual airflow, and airflow setpoint. Group by system and indicate system name and description. Include a link from each air handler graphic.
2. HHW Valves: Provide a heating water valve graphic showing the analog output signal of all heating water valves with signals expressed as a percentage of full open (full heating). Also indicate the discharge air temperature and setpoint of each fan coil, heating system supply and return water temperatures, and the outside air temperature. Provide links between this graphic and the heating plant graphic.
3. Override Report: Show all current operator overrides in the system. The report shall show the point or setpoint overridden, the nominal value, and the override value, the date of the override, and the operator or user who performed the override. Include a link to the applicable graphic.

3.11 TESTING

A. All testing described in this article shall be performed by the contractor and shall make-up part of the necessary verification of an operating system. The testing shall be completed before the Owner is notified of substantial completion.

1. Verify that all control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
2. Verify calibration of all input devices individually. Perform calibration procedures in accordance with manufacturer’s recommendations.
3. Verify that all binary output devices operate properly and that normal positions are correct.
4. Verify that all analog output devices are functional, that start and span are correct, and that direction and normal position are correct.
5. Check all control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Verify that system operation adheres to the stated sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all control loops and optimum start/stop routines.

7. Check each alarm separately by overriding a signal at a value that will trip the alarm. Interlocks shall be tripped using field contacts to check the logic and ensure that the fail-safe condition for all actuators is in the proper direction.
8. Demonstrate interface to the building fire alarm system and that fire alarm trips result in the equipment reaction.

B. Point-to-Point Tests: Perform the following tests for each point and submit documentation prior to requesting acceptance testing:
1. Binary Input: Manually actuate the monitored equipment and compare actual state with that read by the system. Jumper or open wires at the device and verify change of state.
2. Analog Input: Compare sensor reading to that of a calibrated portable measurement device. Lift wire at the device to verify change of state and record default values.
3. Binary Output: Through software, command the field device from the controller and verify the corresponding change of state at the field device.
4. Analog Output: Through software, set the output to three or more values across the full range of actuation and compare with position of controlled device (or output signal for controlled device positions that cannot be visually observed).
5. Data (from Third-Party Controls): Perform the above tests, though the comparison shall be between that provided at the Third-party controller display and the BAS. Perform the above “Binary Output” test for data that represents digital outputs.

C. Functional System Tests: Perform the following tests for all sequences of operation and submit documentation prior to requesting acceptance testing:
1. Develop trend data in graphical form showing the properly damped step response of each control loop.
2. Simulate varying input values to verify reset schedules, and temperature lockouts.
3. Manually initiate system start-ups to verify interlocks and sequencing.
4. Simulate safety device and fire alarm system contact actuation to verify emergency, alarm, and life safety sequences.
5. Simulate day/night changeover to observe occupied, unoccupied, optimum start, and warm-up modes.
6. Simulate seasonal changeovers to observe proper operation of heating and cooling modes.

D. Setpoint Reset History: For setpoints that are reset by zone or system demand (such as duct static pressure, supply air temperature, differential pressure), create reports from high resolution trend data (less than 6-sec intervals), and submit trend data output for review.
1. At the top of the report, indicate system name and description, name of setpoint being reset, and setpoint average, minimum, and maximum values over the report range whenever the reset is active.
2. The body of the report shall list each zone/system driving the reset, including name, hours driving the reset, reset lock-out status, and average value of the variable driving the reset (such as damper/valve position, or cooling control loop output) when the reset is active.

E. Terminal Coil Capacity: Submit trend data in graphical and/or table format showing scheduled design discharge air temperature is being reached at all heating or cooling coils. Note that due to pump/fan diversity, tests likely cannot be performed on an entire building at one time. Divide the test area into at least two groups and take steps to limit flow outside the test group. Air handler coils will be tested separately from the terminal coils they serve.

1. Override all control valves in the test group to 100% to prevent from closing.
2. Put all test group coils into a call for full heating/cooling to drive max cfm.
3. Override boiler/chiller target temp to the design entering water temp to coils.
4. Override source discharge air temp to the design entering air temp to coils.
5. Trend entering air and water temps to validate stable temps thru-out the test.
6. Trend or screen shot airflow and discharge air temp for each coil to validate capacities.

F. Loop Response: Submit trend data output in graphical form showing the step response of each control loop, demonstrating whether the system successfully returns the process variable to setpoint without excessive hunting, offset or overshoot.

1. Each test shall show the loop's response to a change in setpoint which represents a change of actuator position of at least 25% of its full range.
2. The sampling rate shall be from 6-sec to 3-min, depending on the speed of the loop.
3. The trend data shall show for each sample, the setpoint, actuator position, and controlled variable values.
4. Any loop that yields unreasonable under-damped or over-damped control shall require further tuning by the contractor.

G. Optimal Start: Submit trend data output showing the capability of the optimal start algorithm. Change-of-value trends shall include the output status of all optimally started equipment, as well as temperature sensor inputs of affected areas.

H. Demand Limiting: Submit trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-min period. Included in the trend shall be building kW, demand limiting setpoint, and the status of sheddable equipment outputs.

I. Tuning constants shall be set so that continuous oscillation of actuators does not occur. A steady state shall be achievable. Trend logging or other graphical proof of loop tuning stability shall be submitted.

J. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations, and that any other related actions occur as defined.

K. Perform an operational test of each unique graphic display to verify that all items exist, that the appearance and content are correct, that animated objects display properly, and that any special features work as intended.

L. Perform an operational test of each Third-Party interface included as part of the system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics have been completed.

M. Seasonal Testing: Tests delayed until weather conditions are closer to the system design shall be completed during the warranty period as a condition of this contract. Tests shall be executed and documented by the contractor, with any deficiencies noted and corrected.

N. Nuisance Alarms: All alarms which are identified by the Owner during the warranty period as being nuisance alarms (due to numerous in and out-of-alarm conditions), shall be addressed and corrected by the contractor in a manner approved by the Owner.

3.12 ACCEPTANCE

A. Testing described in this article is to be performed in addition to tests the contractor performs as a necessary part of the installation, start-up, and debugging process. Acceptance shall be scheduled with the owner and engineer at least two weeks in advance. The contractor shall submit trend data output in printed and digital format with the request for acceptance testing.

B. Any test that fails to demonstrate operation of the system shall be repeated at a later date. The contractor shall be responsible for any revisions to the hardware or software to successfully complete all tests.

3.13 TRAINING

A. Provide training for designated staff, organized into sessions or modules for different levels of operators listed below. Students will receive one or more of the training packages depending on the knowledge level required. Training shall be furnished via instructor-led classroom sessions, computer-based, and/or web-based training.

B. All training shall be held during normal work hours of 8:00 am to 4:00 pm weekdays as scheduled in advance with the Owner. Training shall include a walk-thru of the job site to locate and identify components.

C. Explain each system and its underlying logic. Describe normal operation and what is expected to be seen on the graphics. Describe abnormal conditions and make recommendations for how staff should respond. Training shall enable the students to accomplish the following objectives:

1. Day-to-Day Operators:
    a. Logging on/off and proficient operation of the system.
    b. Understand system architecture and system components.
    c. Understand system operation and use of operations manuals.
    d. Understand control drawings and location of control components.
    e. Access graphics, point status reports, and trend logs.
    f. Access and adjust setpoints, overrides, and schedules.
    g. Recognize malfunctions by observation of the graphics.
    h. Understand "next steps" when malfunctions are identified.
2. Advanced Operators:
    a. Create, delete, and modify reports.
    b. Create, delete, and modify alarms, including routing.

c. Create, delete, and modify trend logs at user-definable time intervals.

d. Create, delete, and modify systems graphics and other displays.

e. Adjust, calibrate, and replace system components.

f. Perform system diagnostic procedures and troubleshooting.

g. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.

3. System Managers:

a. Maintain software and prepare backups.

b. Interface with third-party operator software.

c. Understand password security and add new users.

D. Provide for a minimum of two 4-hr, on or off-site training classes for up to six of the Owner's personnel at the project site and/or the Owner’s Operator Interface Server location.

E. Provide for a minimum of 16-hrs additional on-site control system demonstration, training and/or assistance for a period of one-year from final completion of the project.

END OF SECTION

SECTION 25 3500 - CONTROLS INSTRUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sensors, switches, and transmitters.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: Product data sheets for each type of product showing:

1. Product description with complete technical data, performance curves, and product specification sheets. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Installation, operation, and maintenance instructions, including factors affecting performance. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

C. Indicate locations of sensors, switches, and transmitters on control drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors and transmitters to include in operation and maintenance manuals.

1.6 WARRANTY

A. Warrant supplied products with appurtenances to be free from defects in material and workmanship for 1-year from the date of substantial completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Instruments shall operate without performance degradation under ambient environmental temperature, pressure, humidity, and vibration conditions encountered for installed locations.

1. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance.
2. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by the instrument and application.

B. Sensors and switches located in occupied spaces shall have concealed sensing elements with ventilated enclosures or stainless steel gasketed plates sized to fit a standard single-gang junction box. Provide concealed or exposed setpoint adjustment where indicated.

C. Wireless sensors, transmitters, or other wireless devices are not permitted unless approved in writing by the engineer for specific locations.

D. Strap-on sensors are not permitted unless approved in writing by the engineer.

2.2 TEMPERATURE INSTRUMENTS

A. Temperature sensors shall be thermistor or RTD type with a minimum accuracy of +/- 0.5ºF throughout the specified temperature range.

B. Outside air temperature sensors shall consist of a single device sensor, ventilated non-metallic sun-shield, utility box for terminations, and weather-tight gaskets.

C. Single point duct temperature sensors shall consist of stainless steel or platinum sensing element, junction box for wiring connections, and gaskets to prevent air leakage or vibration.

D. Averaging duct temperature sensors shall consist of a copper or stainless-steel averaging element, junction box for wiring connections, and gaskets to prevent air leakage or vibration. Provide 2-ft of sensing element for every square foot of coil face area.

E. Liquid immersion temperature sensors shall include the sensing element, a brass or stainless-steel thermowell, and utility head for wiring connections.

F. Wet-bulb temperature sensors shall be suitable for duct or outside mounting and consist of sensor element, ventilated enclosure, sun-shield, utility box, and water-tight gaskets.

G. On-off thermostat shall be bi-metal actuated open contact; bellows actuated enclosed snap-switch type, or equivalent solid-state type with electrical rating to meet the application. Ventilated enclosure, concealed/exposed setpoint adjustment, and positive-off feature.

H. Combination thermostat and fan switches shall be line voltage thermostat with two, three, or four position, push-button, or lever-operated fan switch.

2.3 PRESSURE INSTRUMENTS

A. Static air pressure sensors shall have a linear output voltage signal, with adjustable zero and span. Tubing shall connect to a pitot tube or other sensing device. Tubing shall not pass thru ductwork or equipment housings.

B. Steam and water gauge pressure sensors shall include connections secured to a stainless-steel diaphragm sensor with a gasketed, watertight housing for remote mounting.

C. Differential pressure sensors (air or liquid) shall be temperature compensated with an accuracy of +/- 1% of range and repeatability/hysteresis of 0.5% of range.

D. Differential air pressure sensors shall provide a linear output voltage signal, capable of over-pressurization to 10-psig without zero shift.

E. Differential liquid pressure sensors shall consist of a pressure tap secured to a stainless-steel diaphragm and an electric sensor enclosed in a gasketed watertight case.

F. Outdoor air pressure tips shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Provide a surge dampener with a 30-sec time constant.

G. Differential pressure switches shall be diaphragm operated single-pole, double-throw snap switch type with setpoint adjustment and enclosed setpoint indicator and scale.

2.4 MOISTURE INSTRUMENTS

A. Relative humidity sensors shall be solid-state with 0 to 100-percent range, 2-percent accuracy from 10 to 90-percent, factory calibrated and NIST traceable. Output signal to match requirements, linear to percent relative humidity.

B. Humidistats shall provide two-position control with field adjustable setpoint. Single-pole double-throw snap switch type, line voltage or low voltage type suitable for the application, 10 to 95-percent range, 5-percent accuracy, and 5-percent differential.

2.5 GAS INSTRUMENTS

A. Carbon dioxide sensors shall be non-dispersive infrared absorption type, zero to 2000 ppm range, 2-percent accuracy of reading +/- 30 ppm, repeatability within 1-percent of full scale, and stable within 5-percent of full scale after 5-years. Output signal to match requirements, linear to CO2 concentration in ppm. Single channel sensor with self-calibration feature.

2.6 MOTION INSTRUMENTS

A. Motion sensors shall be passive-infrared, wall or ceiling mounted style with dry contact closure and adjustable off-delay. Detecting occupancy by sensing a combination of heat and movement in the coverage area.

2.7 POSITION INSTRUMENTS

A. Control valve and damper position indication shall consist of a potentiometer mounted on the valve actuator or in a housing.

B. Position switches shall use cam action, lever, or proximity type rotary switches with damper brackets and connecting rods. Tip switches or other position switches that contain mercury are not permitted.

C. Float type level switches shall include single-pole double-throw snap acting contacts. Electronics shall be housed in a watertight enclosure.

2.8 ELECTRICAL DEVICES

A. Current switches shall be induction type clamped over single phase conductor of AC power. Solid state sensor with adjustable threshold and normally open contacts. Each switch shall be selected for proper operating range of current, and output signal to match requirements.

B. All control relays shall be UL-listed with contact rating, configuration, and coil voltage for the application. Relays used for inline control start/stop of line voltage motors shall have a current rating of at least 150% full load amps

C. Control transformers shall be UL-listed. Primary and secondary sides shall be class 2 current limiting type, fused in accordance with the NEC. Transformers shall be sized such that the connected load is not greater than 80% of the rated capacity.

D. Emergency shut-off switches shall be heavy-duty, two-position, push-pull, maintained contact, mushroom style push button switch. Provide hinged easy-open protective clear cover to prevent accidental actuation.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Installation shall be performed by professionals in a workmanlike manner and in compliance with the contract documents, the electrical specifications, the national electric code, applicable local codes, and authorities having jurisdiction.

B. Component locations are the responsibility of the installing contractor. All control system components shall be installed in locations to properly sense the controlled medium.

C. Installation shall not interfere with required or designated equipment clearances. Install products level, plumb, parallel, and perpendicular with building construction.

D. Install products in locations that are accessible and that will permit calibration, maintenance, and replacement, from floors, equipment platforms, or catwalks.

E. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

F. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged.

G. Patch, flash, grout, seal, and refinish openings to match adjacent condition. Firestop penetrations made in fire-rated assemblies and caulk seal penetrations made in acoustically rated assemblies.

H. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection.

I. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers, power wiring, and raceways. Comply with applicable sections herein.

J. Conduit, junction boxes, and other rough-in indicated on electrical drawings is a courtesy only. This contractor is responsible for all controls installation.

K. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

3.2 GENERAL INSTRUMENT INSTALLATION

A. Rough-in instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.

B. Install switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied spaces unless indicated specifically on the drawings.

C. Install switches and transmitters associated with individual air-handling units and connected ductwork and piping, co-located in the air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.

D. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

E. Install instruments (except pressure gauges) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to the instrument.

F. Install instruments in dry gas and non-condensable vapor piped services above their process connection point. Slope process connection lines up to the instrument.

G. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, hvac equipment, smoke detectors, fire-suppression systems, and partition assemblies.

H. Coordinate layout and installation of wall-mounted devices with other wall-mounted devices. Align centerline with adjacent devices. Align centerline with devices above.

I. Protect products installed outdoors from solar radiation and building and wind effects with stand-offs and shields constructed of stainless-steel.

J. Instruments having performance impacted by the temperature of the mounting substrate shall be isolated with an insulating barrier to eliminate effect.

K. Mount temperature instruments in user-occupied spaces to match the height of light switches. Comply with applicable codes and accessibility requirements.

L. Mount switches and transmitters located in mechanical equipment rooms within a range of 42 to 72 inches above the adjacent floor, grade, or service platform.

M. For applications with transmitters, mount the transmitter remote from the sensor in an accessible and serviceable location.

N. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage seal classes indicated.

O. In finished areas, install recessed electrical boxes within walls. In unfinished areas, electrical boxes may be surface mounted.

P. Align electrical boxes with other electrical devices such as visual alarms and light switches. Where possible, align in both horizontal and vertical axis.

Q. Install protective guards where wall sensors are mounted in public areas subjected to damage or where mounted in public areas with adjustable setpoints..

3.3 TEMPERATURE INSTRUMENT INSTALLATION

A. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location on a permanent north exposure. Do not mount to other equipment. Indicate locations on the control drawings.
2. Protect installed sensor from solar radiation and other influences that could impact performance.

B. Single-Point Duct Temperature Sensor Installation:

1. Install sensors in ducts with sensitive portion of the element installed in the center of the duct cross section and located to sense near average temperature. Do not exceed 24-inches in sensor length. Rigidly support sensor to duct and seal penetration airtight.
2. Install return air sensor in location that senses temperature without influence from outdoor air or mixed air.
3. Install discharge air sensors in locations that sense temperature without influence from coils or other devices.
4. Install air terminal unit discharge air sensors at least 4-ft downstream of reheat coils.

C. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20-square feet and larger.
2. Install sensor length to maintain coverage over the entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support each sensor with manufacturer-furnished clips to keep the sensor taut throughout the entire length.

D. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over the entire cross-sectional area of the air tunnel.
2. Fasten and support each sensing element with manufacturer-furnished clips to keep elements taut throughout the entire length.
3. Mount switches outside of the airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.

E. Liquid Temperature Sensor Installation:

1. Install thermal wells where the most accurate reading may be sensed. Do not install wells within ten pipe diameters of any mixing or diverting connection.
2. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
3. For insulated piping, install thermowells with extension neck to extend beyond the face of the insulation.
4. Include thermal conducting compound within the well to insure good heat transfer to the sensor.

3.4 PRESSURE INSTRUMENT INSTALLATION

A. Duct Pressure Sensors:

1. Install sensor in accordance with manufacturer's instructions, using manufacturer's recommended upstream and downstream distances.
2. Install mounting hardware and gaskets to make sensor installation airtight.
3. Route tubing from the sensor to the transmitter. Use compression fittings at terminations.
4. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

B. Outdoor Pressure Sensors:

1. Install roof-mounted sensor in least-noticeable location and as far away from exterior walls as possible. Locate wall-mounted sensor in an inconspicuous location.
2. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
3. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
4. Connect roof-mounted signal pipe exposed to outdoors to building grounding system.

C. Air-Pressure Differential Sensors:

1. Install tubing and connect the outdoor reference for space static pressure to a sensing tip 10-ft minimum above the highest point of the building. Install a low air pressure surge dampener with a 30-sec time constant.
2. Install tubing and connect the high-pressure port for space static pressure to a sensing tip mounted behind a thermostat cover at the location shown on the drawings.
3. Install tubing and connect the high-pressure port for duct static pressure sensor to a sensing tip at a location 75% of the distance from the first terminal unit box to the most remote box.

D. Air-Pressure Differential Switches:

1. Install air pressure sensors in the system for each switch connection. Install sensors in an accessible location for inspection and replacement.
2. Install an access door in ducts and equipment to access sensors that cannot be inspected and replaced from the outside.

3. Install switches in an easily accessible location serviceable from the floor. Do not mount switches on rotating equipment.
4. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
5. Install switches adjacent to the system control panel or in the vicinity of the system connection.

E. Liquid-Pressure Differential Sensors:

1. Locate sensors across the heating/cooling coil circuit at the equipment hydraulically furthest from the pump. Locations shall be indicated on the control drawings.
2. Install a three-valve manifold assembly to allow isolation and bypass of operating pressures.
3. Install snubbers to prevent system pressure surges from being fully transmitted to the sensor.

F. Liquid-Pressure Differential Switches:

1. Where process connections are located in mechanical equipment rooms, install the switch in a convenient and accessible location near the system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to the mechanical room near the system control panel.
3. Where multiple switches are serving the same system, install switches to provide service personnel a single and convenient location for inspection and service.
4. Connect process tubing from the point of system connection and extend to the switch. Connection shall be full size of the switch connection, but not less than 1/2-in.
5. Install isolation valves as close to the system connection as practical. Install a dirt leg and drain valve at each switch connection.
6. Install switches in an easily accessible location serviceable from the floor. Do not mount switches on rotating equipment.
7. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.

3.5 ADJUSTMENT CALIBRATION AND TESTING

A. Sensors: Check sensors at 0, 50, and 100% of project design values.

B. Switches: Calibrate switches to make or break contact at set points indicated.

C. Transmitters: Check and calibrate transmitters at 0, 50, and 100% of project design values.

D. Occupancy Adjustments: Within 12-months from the date of substantial completion, provide on-site assistance in adjusting the system to suit actual occupied conditions.

3.6 CHECKOUT

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location, length, and accessibility.

C. Verify sensing element type and proper material.

D. Verify that wiring is correct and secure.

E. Check instrument tubing for proper isolation, fittings, slope, drains, material, and support.

F. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

END OF SECTION

SECTION 25 3510 - CONTROL VALVES AND ACTUATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control valves.

B. Electric actuators.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: Product data sheets showing:

1. Product description with complete technical data, performance curves, and product specification sheets. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Installation, operation, and maintenance instructions, including factors affecting performance. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

C. Delegated-Design: Schedule and design calculations for control valves and actuators, including the following:

1. Indicate service, size, arrangement, flows, flow coefficient, pressure drop, normal position, close-off rating, and pressure rating for each system.

2. Include actuator selection supported by calculations required to move, close, and seal the valve at design conditions.

3. Include model numbers, dimensions, and maintenance clearance for installation.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves and actuators to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Products: Listed and labeled as suitable for the purpose specified and indicated.

B. Review approved equipment submittals to confirm design data specifics like flow, pressure difference, service temperature, etc to confirm selections.

1.7 STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.8 WARRANTY

A. Warrant supplied products with appurtenances to be free from defects in material and workmanship for 1-year from the date of substantial completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional to size products where indicated.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

F. Determine control valve sizes and flow coefficients by ISA 75.01.01. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Selection Criteria:

1. Valve pattern, three-way or straight-thru, shall be as indicated on the drawings.

2. Two-port modulating valves shall be pressure independent type. Two-position valves may be pressure dependent type.

3. Valves shall be rated for a minimum of 150-percent of the system operating pressure, but not less than 125-psig.

4. Pressure drop through each circuit shall be considered. Valves shall be selected with a valve authority of 0.50 or greater. Valve authority shall be indicated on the submittals.
5. Selection shall consider viscosity, flashing, and cavitation corrections. Valves shall have stable operation throughout the full range of operation, from design to minimum Cv.
6. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
7. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
8. Modulating butterfly valves shall have linear or equal percentage flow-throttling characteristics.
9. Two-position control valves shall be line size unless otherwise indicated.

H. Circuits with pressure independent control valves:

1. Balancing valves are not required in branches or loops where pressure independent control valves are installed.
2. Autoflow valves are prohibited in branches or loops where pressure independent control valves are installed.
3. Balancing valves or autoflow valves may be required for circuits with multiple coil sections.
4. Pressure ports are required in the circuit for the test and balance agency to measure flow.

2.2 CONTROL VALVES

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated or comparable products by one of the following:

1. Belimo Aircontrols, Inc: www.belimo.com.
2. IMI Hydronic Engineering: www.imi-hydronic.com.
3. Johnson Controls: www.johnsoncontrols.com.
4. Schneider Electric: www.schneider-electric.us.
5. Siemens Industry Inc: www.siemens.com.
6. Substitutions: See Section 20 0500 for substitution procedures.

B. Water service control valves shall be as follows:

1. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
2. Rotary-type control valves shall have Cv falling between 65 and 75 degrees of valve full-open position and minimum valve Cv between 15 and 25 percent of open position.
3. Minimum Cv shall be calculated at 10-percent of design flow, with a coincident pressure differential equal to the system design pump head.
4. Select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 3 to 5-psig at design flow unless otherwise indicated.

5. Ball Valves: Cast bronze, dezincification-resistant brass, or nickel-plated forged brass body with stainless steel ball and stem, PFTE seats, blow-out proof stem with reinforced PTFE or EPDM packing, and characterizing disc.
6. Globe Valves: Cast bronze with threaded connection for 2-inch and smaller, or iron body with flanged connections for 2.5-inch and larger. Top guided plug, stainless steel trim, PFTE packing and threaded connections. Replaceable seats and plugs.
7. Butterfly Valves: Cast iron or ductile iron body with stainless steel disc and shaft, and reinforced EPDM or PTFE seat. Replaceable seat, disc, and shaft bearings. Bi-directional bubble-tight shut-off at 250 psig.

C. Pressure Independent Control Valves: Two-port pressure independent control valves (PICV) or pressure independent characterized control valves (PICCV) shall integrate three functions into a single device (control valve, flow limiter, and automatic pressure regulator), and be capable of providing effective modulating control.
1. Valves may be full-stroke (control and flow setting functions separated) or stroke limited (control and flow setting functions combined).
2. Stroke limited valves may be of the lift and lay type (rising stem) or the multi-turn or characterized ball valve type (rotating stem).
3. All valves and actuators shall be properly matched to provide intrinsic equal percentage characteristics.
4. Select valves based on flow. Provide the smallest valve that can deliver 120% of the design flow at less than 5.0 psi. Indicate maximum flow on the submittals.
5. Supply p/t ports with valves if they are intended to be used for flow measurement.

D. Control valve applications: Valves shall be two-way or three-way type for two-position or modulating service as indicated.
1. Two-way modulating applications: Pressure independent control valves.
2. Two-way two-position applications: Ball valves, globe valves, or butterfly valves.
3. Three-way applications: Ball valves, globe valves, or butterfly valves.

2.3 ELECTRIC ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated or comparable products by one of the following:
1. Belimo Aircontrols, Inc: www.belimo.com.
2. IMI Hydronic Engineering: www.imi-hydronic.com.
3. Johnson Controls: www.johnsoncontrols.com.
4. Schneider Electric: www.schneider-electric.us.
5. Siemens Industry Inc: www.siemens.com.
6. Substitutions: See Section 20 0500 for substitution procedures.

B. Design for direct mounting on the device; adjustable angle of rotation or range of actuation; and built-in overload protection.

C. Size each motor for 150% of the application requirement and with sufficient reserve power to provide smooth action.

D. Provide actuators capable of close off against a pressure greater than the respective pump system shut-off head.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators: Capable of stopping at all points across the full range, and starting in either direction from any point in the range. Control input signal:

   1. Proportional: Actuator drives proportional to the input signal and modulates throughout its angle of rotation. Suitable for 0 to 10 Vdc, 2 to 10 Vdc, or 4 to 20 mA signals.

   2. Floating point: Three-wire, bi-directional motor actuators controlled by binary point pairs are not acceptable, unless approved in writing.

G. Select actuators to fail in the desired position in the event of a power failure. Fail positions are as follows unless otherwise indicated:

   1. Chilled water: normally closed.

   2. Heating water: normally open.

   3. Terminal units: last position.

   4. Convective units: normally open.

H. Construction:

   1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.

   2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.

   3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:

   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.

   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Position Feedback:

   1. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.

   2. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open or close positions.

   3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

K. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are not permitted unless approved in writing.

L. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

M. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to the valve shaft without the need for connecting linkages.
2. Attach actuator to the valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

N. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4/4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

O. Stroke Time:

1. Select operating speed to be compatible with equipment and system operation.
2. Move valve to the failed position within 15-seconds.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Installation shall not interfere with required clearances for mechanical or electrical equipment.

C. Install products in locations that are accessible and that will permit calibration, maintenance, and replacement, from floors, equipment platforms, or catwalks.

D. Properly support valves and actuators, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

E. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged.

F. Patch, flash, grout, seal, and refinish openings to match adjacent condition. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

G. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers, power wiring, and raceways. Comply with applicable sections herein.

3.2 VALVE AND ACTUATOR INSTALLATION

A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with piping. Install in accordance with the manufacturer's instructions.

B. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and equipment.

C. Ensure that isolation valves are installed so that the control valve body may be serviced without draining the supply or return side piping system. Unions or flanges shall be installed to allow drop-in and out valve installation.

D. Install pipe reducers for valves smaller than line size. Position reducers as close to the valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

E. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around and between valves and adjacent surfaces.

F. Orientation:

1. Install valves in a position to allow full stem movement.
2. Where possible, install globe and ball valves in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
3. Where possible, install butterfly valves in horizontal piping with stems in the horizontal position and with low point of the disc opening with direction of flow.

G. Leave a minimum of 6-inches of loop per cable or wire end to ease future servicing needs. Accommodate excess neatly into a loop inside junction box.

3.3 CHECKOUT PROCEDURES

A. Control valve and actuator checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Verify that control valves are installed correctly for flow direction.

5. Verify that valve body attachment is properly secured and sealed.
6. Verify that valve actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

END OF SECTION

SECTION 25 3520 - CONTROL DAMPERS AND ACTUATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control dampers.

B. Electric actuators.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: Product data sheets showing:

1. Product description with complete technical data, performance curves, and product specification sheets. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Installation, operation, and maintenance instructions, including factors affecting performance. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

C. Delegated-Design: Schedule and design calculations for control dampers and actuators, including the following:

1. Indicate service, size, flows, pressure drop, normal position, leakage class, and blade configuration for each system.

2. Include actuator selection criteria and the maximum leakage rate at the operating static pressure differential.

3. Include model numbers, orientation and axis of frame, and blade rotation for installation.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers and actuators to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Products: Listed and labeled as suitable for the purpose specified and indicated.

B. Review approved equipment submittals to confirm design data specifics like flow, pressure difference, service temperature, etc to confirm selections.

1.7 STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.8 WARRANTY

A. Warrant supplied products with appurtenances to be free from defects in material and workmanship for 1-year from the date of substantial completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional to size products where indicated.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

F. Control dampers shall be parallel or opposed blade type as indicated below.

1. When mixing two airstreams, parallel blade type shall be used with blades arranged to direct airstreams toward each other.

2. Two-position or equipment isolation dampers may be parallel or opposed blade type.

3. All other modulating damper applications shall use the opposed blade type.

G. Selection Criteria:

1. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.

2. Select modulating dampers for a pressure drop of 5-percent of fan total static pressure unless otherwise indicated.
3. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated or comparable products by one of the following:
   1. Pottorff: www.pottorff.com.
   2. Ruskin Company: www.ruskin.com.
   3. TA Morrison & Co: www.tamco.com.
   4. Substitutions: See Section 20 0500 for substitution procedures.

B. Construction:
   1. Damper frames shall be a minimum 0.080-inch thick extruded aluminum channel. Damper blades shall be extruded aluminum with airfoil-shape profile, not to exceed 6-inch width or 48-inch length.
   2. Blade edges and top and bottom of the frame shall be provided with replaceable neoprene seals. Side seals shall be spring-loaded stainless steel or extruded silicone.
   3. Damper shaft bearings shall be as recommended by the manufacturer for the application, oil impregnated sintered bronze or better.
   4. Individual damper sections shall not be larger than 48-inches wide by 60-inches high. Provide a minimum of one damper actuator per section.
   5. Dampers shall have corrosion-resistant linkages that are readily accessible for maintenance.
   6. Pressure drop shall not exceed 0.10-inches w.c. at a wide open face velocity of 1,500 fpm.

C. Control dampers shall be an ultra-low leakage type, AMCA Class 1A, not to exceed 3-cfm per square foot leakage, against 1-inch wg differential static pressure. Tamco Series 1000 or Ruskin Model CD50.

D. Intake and relief/exhaust dampers exposed to the outside air shall be ultra-low leakage AMCA Class 1A type with blades internally insulated with polyurethane foam. Tamco Series 9000 or Ruskin Model TED50.

2.3 ELECTRIC ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated or comparable products by one of the following:
   1. Belimo Aircontrols, Inc: www.belimo.com.
   2. Johnson Controls: www.johnsoncontrols.com.
   3. Schneider Electric:www.schneider-electric.us.

4. Siemens Industry Inc: www.siemens.com.
5. Substitutions: See Section 20 0500 for substitution procedures.

B. Design for direct mounting on the device and attachment to the driving shaft; adjustable angle of rotation or range of actuation; and built-in overload protection.

C. Size each motor for 150% of the application requirement and with sufficient reserve power to provide smooth action.

D. Damper actuators shall provide 95-degree rotation maximum, with built-in adjustable stop to limit rotation to that of the damper and/or to meet test and balance requirements.

E. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

F. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

G. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

H. Provide damper actuators capable of full operation for the size and pressure conditions.

I. Two-Position Actuators: Single direction, spring return or reversing type.

J. Modulating Actuators: Capable of stopping at all points across the full range, and starting in either direction from any point in the range. Control input signal:

1. Proportional: Actuator drives proportional to the input signal and modulates throughout its angle of rotation. Suitable for 0 to 10 Vdc, 2 to 10 Vdc, or 4 to 20 mA signals.
2. Floating point: Three-wire, bi-directional motor actuators controlled by binary point pairs are not acceptable, except on terminal unit box dampers only.

K. Select actuators to fail in the desired position in the event of a power failure. Fail positions are as follows unless otherwise indicated:

1. Supply air: normally open.
2. Return air: normally open.
3. Outside air: normally closed.
4. Exhaust/Relief air: normally closed.
5. Mixed air: open to return air, closed to outside air.
6. Face and bypass: open to bypass, closed to face.

L. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

M. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

N. Position Feedback:

1. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
2. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open or close positions.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

O. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are not permitted unless approved in writing.

P. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

Q. Damper Attachment:

1. Unless otherwise required for damper interface, provide an actuator designed to be directly coupled to the damper shaft without the need for connecting linkages.
2. Attach actuator to the damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

R. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4/4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

S. Stroke Time:

1. Select operating speed to be compatible with equipment and system operation.
2. Move damper to the failed position within 15-seconds.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Installation shall not interfere with required clearances for mechanical or electrical equipment.

C. Install products in locations that are accessible and that will permit calibration, maintenance, and replacement, from floors, equipment platforms, or catwalks.

D. Properly support dampers and actuators, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

E. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged.

F. Patch, flash, grout, seal, and refinish openings to match adjacent condition. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

G. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers, power wiring, and raceways. Comply with applicable sections herein.

3.2 DAMPER AND ACTUATOR INSTALLATION

A. Damper submittals shall be coordinated for type, quantity, size, and duct configuration to ensure compatibility with ductwork. Install in accordance with the manufacturer's instructions.

B. Install smooth transitions, not exceeding 30-degrees, to dampers a different size than adjacent duct. Install transitions as close to the damper as possible but at distance to avoid interference and impact to performance.

C. Duct openings shall be free of any obstructions or irregularities that might interfere with blade or linkage rotation or actuator mounting. Openings shall be square, straight, level, and slightly larger than damper dimensions.

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Damper blades, axles, and linkage must operate without binding. Cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

F. Damper sections and multiple section assemblies shall be completely square and free from racking, twisting, or bending.

G. Unless specifically designed for vertical blade application, dampers must be mounted with the blade axis horizontal.

H. Install extended shaft or jack-shaft according to the manufacturer's instructions. Provide a visible and accessible indication of damper position on the drive shaft end.

I. For duct-mounted and equipment-mounted dampers, install a visible and accessible indication of damper position from the outside.

J. For low-leakage dampers, tighten the linkage with the actuator powered to a 5-degree open position to compress the seals.

K. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.

2. Install dampers with at least 24-inches of clear space on sides of dampers requiring service access.

L. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.

2. Install access doors in duct or equipment located upstream of dampers to allow service personnel to hand clean any portion of damper, linkage, and actuator.

M. Where dampers are installed in insulated duct, provide stand-off actuator mounting kits and shaft extensions equal to the depth of the insulation. Do not cut insulation.

N. Leave a minimum of 6-inches of loop per cable or wire end to ease future servicing needs. Accommodate excess neatly into a loop inside junction box.

3.3 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.

2. Check dampers for proper location and accessibility.

3. Verify that control dampers are installed correctly for flow direction.

4. Verify that proper blade alignment, either parallel or opposed, has been provided.

5. Verify that damper frame attachment is properly secured and sealed.

6. Verify that damper actuator and linkage attachment are secure.

7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.

8. Verify that damper blade travel is unobstructed.

END OF SECTION

SECTION 25 3530 - FLOW STATIONS AND FLOW METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Airflow measuring stations.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: For each type of product, including the following:

1. Product description with complete technical data, performance curves, and product specification sheets. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Installation, operation, and maintenance instructions, including factors affecting performance. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

C. Delegated-Design: Submit schedule and design calculations for flow instruments, including the following:

1. Flow at project design and minimum flow conditions.
2. Velocity at project design and minimum flow conditions.
3. Pressure drop at project design and minimum flow conditions.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Products: Listed and labeled as suitable for the purpose specified and indicated.

B. Review approved equipment submittals to confirm design data specifics like flow, pressure difference, service temperature, etc to confirm selections.

1.7 STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.8 WARRANTY

A. Warrant supplied products with appurtenances to be free from defects in material and workmanship for 1-year from the date of substantial completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Select and size products to achieve specified performance requirements.

B. 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.

C. Backup Power Source: Systems and equipment served by a backup power source shall have associated instrumentation served from a backup power source.

2.2 AIRFLOW MEASURING STATIONS

A. Manufacturers: Subject to compliance with requirements, provide basis of design products indicated or comparable products by one of the following:

1. Ebtron Inc: www.ebtron.com.

2. Substitutions: See Section 20 0500 for substitution procedures.

B. Airflow measuring devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node. Each airflow measuring device shall be provided with a microprocessor-based transmitter and one or more sensor probes.

C. Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors, individually calibrated to NIST-traceable airflow and temperature standards. The manufacturer shall determine the number and length of sensor probes to be used for each application and recommend placement for each location indicated on the drawings.

D. Each sensor node shall be individually calibrated at 16-points to have an accuracy of +/- 2% of reading over an operating range of 0 to 5000 feet per minute. Each sensor node shall be individually calibrated at 3-points to have a temperature accuracy of +/- 0.15°F over an operating range of -20 to 160°F and a relative humidity range of 0 to 100%.

E. Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.

F. Transmitter shall include a 16-character, alpha-numeric, LCD display, and be provided with the following communications options:

1. Two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals.

2. One isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection, or one isolated Ethernet or BACnet-IP network connection.

G. Large Ducts and Intakes: Provide probe and sensor node configurations and a transmitter compatible with the BAS for each measurement location indicated. Ebtron model GTx116-P.

H. Fan Arrays: Provide throat mount fan inlet probes and sensors and a transmitter compatible with the BAS for each fan indicated. Ebtron model GTx108-F.

I. Small Ducts and Terminal Units: Provide low flow device and transmitter compatible with the system for each location indicated. Ebtron model EF-x1000-T.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks.

D. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

E. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent conditions.

F. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

G. Rough-in instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.

H. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units, co-located in the air-

handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.

I. Install airflow and liquid flow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on the drawings.

J. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

K. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.

L. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on drawings. Mounting height shall comply with codes and accessibility requirements.

M. Furnish and install electrical power to products requiring electrical connections. Furnish and install circuit breakers, power wiring, and raceways. Comply with applicable sections herein.

3.2 AIRFLOW MEASURING STATION INSTALLATION

A. Install stations in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.

B. Installed sensors shall be accessible for visual inspection and service. Install access doors in the duct upstream of the sensor to allow service personnel to hand clean sensors.

C. At packaged rooftop units, install within the unit cabinet; do not attach to the intake hood. Consult a factory representative and install in an approved location only.

3.3 CHECKOUT PROCEDURES

A. Description:

1. Check instruments for proper location and accessibility.
2. Check out installed products before continuity tests, leak tests, and calibration.
3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
4. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that recommended upstream and downstream distances have been maintained.
4. Inspect instrument tag against approved submittal.

3.4 ADJUSTMENT CALIBRATION AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and certified. Calibrate according to instrument instruction manual supplied by the manufacturer.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. Field instruments and equipment and procedures used for calibration shall meet the instrument manufacturer's recommendations.
4. Check voltage, current, and resistance signals at zero, 50, and 100 percent of operating span using precision meters. Check binary signals using a jumper wire.
5. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.
6. If performance cannot be achieved after calibration, replace out-of-tolerance instruments.

END OF SECTION

SECTION 25 3550 - VARIABLE FREQUENCY CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Separately enclosed, preassembled, combination variable frequency controllers for speed control of three-phase induction motors.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Unless otherwise indicated, submittals shall be arranged according to individual sections and submitted separately. Do not combine into a comprehensive package.

B. Product Data: Product data sheets showing:

1. Rated capacities, operating characteristics, electrical characteristics, furnished specialties, and accessories.
2. Include views of enclosure, overall dimensions, required clearances, and location/size of each field connection.
3. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drive.
4. Include altitude derate method/calculations for installations above 3300 feet elevation.
5. Include diagrams for power, signal, and control wiring.
6. Indicate short circuit current ratings.

1.5 CLOSEOUT SUBMITTALS

A. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

B. Maintenance Data: Include routine preventive maintenance schedule.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and labeled as suitable for the purpose specified and indicated.

C. Manufacturer Qualifications: Must have a minimum of 25-years of documented experience specializing in variable frequency controllers.

1.7 STORAGE AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Handle carefully to avoid damage to components, enclosure, and finish.

1.8 WARRANTY

A. Warrant supplied products with appurtenances to be free from defects in material and workmanship for 5-years from the date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. ABB: www.abb.com
2. Danfoss Inc: www.danfoss.com
3. Johnson Controls: www.johnsoncontrols.com
4. Siemens Industry Inc: www.usa.siemens.com
5. Yaskawa: www.yaskawa.com
6. Substitutions: See Section 20 0500 for substitution procedures.

2.2 DESCRIPTION

A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated current, voltage, and horsepower, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.

1. Employ microprocessor-based inverter logic isolated from power circuits.
2. Employ pulse-width-modulated inverter system.
3. Design for ability to operate controller with motor disconnected from output.
4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places accessible only to qualified personnel.

2.3 OPERATING REQUIREMENTS

A. Variable speed drives must operate, without fault or failure, when supply voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.

B. Motor Nameplate Voltage: 208/460 volts, three phase, 60 Hertz.

C. Displacement Power Factor: 0.98 over the entire range of operating speed and load.

D. Starting Torque: 110% of rated full load amps for 60-sec, 150% of FLA peak.

E. Operating Ambient: 0-deg C to 40-deg C indoors, 0-deg C to 45-deg C outdoors.

F. Humidity: 0% to 95% non-condensing.

G. Volts Per Hertz Adjustment: Plus or minus 10 percent.

H. Acceleration Rate Adjustment: 1 to 6,000 seconds.

I. Deceleration Rate Adjustment: 1 to 6,000 seconds.

J. Minimum Efficiency: 96% at half speed; 98% at full speed.

K. Altitude: Derate to 6400 ft elevation.

L. Input Signal: Match control signal.

M. Suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes.

N. Include diagnostic fault indication, time and date stamped fault storage, and heat sink cooling fan operating hours.

O. Provide controllers with listed short circuit current rating not less than available fault current at the installed location as indicated on the drawings.

P. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

Q. Include EMI/RFI filters. The onboard RFI filter shall allow the entire drive assembly to be CE Marked. The drive shall meet the product standard EN 61800-3 for First Environment restricted.

2.4 COMPONENTS

A. Furnish Hand-Off-Auto selector switch and manual speed control.

B. Control Power Source: Separate circuit.

C. Display: Integral digital display to indicate output voltage, output frequency, and output current.

D. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, over-temperature, and input power ON.

E. Door Interlocks: Include mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

F. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.

G. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

H. Disconnecting Means: Include integral circuit breaker on the line side of each controller.

I. Wiring Terminations: Match conductor materials and sizes indicated.

2.5 BAS INTERFACE

A. Variable frequency controllers shall include embedded BACnet protocol for network communications, accessible via an RS-422/485 communications port.

B. Variable frequency controllers shall be provided with the following minimum interface contacts:

1. Input Signal Interface:

a. A minimum of one multifunction programmable digital input for external run/stop of the variable speed controller.

b. A minimum of one programmable analog input for an external speed control signal. Input shall accept 0-10 Vdc or 4-20 mA.

2. Remote Indication: A minimum of two programmable dry-circuit relay outputs to indicate:

a. Motor running.

b. Fault indication.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Select and install overload heater elements in motor controllers to match installed motor characteristics.

D. Identify controllers with plastic laminate equipment labels as described elsewhere in the mechanical specifications.

E. For systems where the drive is not “line of sight” to the connected load and a remote safety disconnect is used, a safety orange label must be provided on the remote disconnect cover indicating “Do Not Open Disconnect without first stopping the VFD”.

3.3 FIELD QUALITY CONTROL

A. Provide service of the manufacturer's field representative to prepare and start controllers.

B. Inspect wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

C. Test insulation resistance for each controller element, component, connecting motor supply, feeder, and control circuits. Test continuity of each circuit.

D. Verify that voltages are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify engineer before starting the motor.

E. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

F. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

G. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

H. Prepare test and inspection reports, including a certified report that identifies and describes the results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.4 ADJUSTING AND CALIBRATION

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features.

B. Clear events memory after final acceptance testing and prior to substantial completion.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of variablefrequency controllers in automatic and manual modes.

B. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain variable frequency controllers.

END OF SECTION

SECTION 25 9500 - BAS DRAWINGS AND SEQUENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System architecture diagrams.

B. Schematic control drawings.

C. Sequence of operations.

D. Instrumentation lists.

E. Points lists.

1.2 RELATED REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

1.3 REFERENCE STANDARDS

A. Materials, equipment, installation, and workmanship shall comply with the most restrictive of local, state, and federal authority's codes and ordinances.

B. The latest edition of a reference shall be applicable to this project. All amendments adopted prior to the effective date of this Contract shall also be applicable.

C. American Society of Heating, Refrigeration, and Air Conditioning Engineers:

1. ASHRAE Guideline 36 - High Performance Sequences of Operations for HVAC Systems.

1.4 ACTION SUBMITTALS

A. See Section 20 0500 for submittal requirements. Control drawing submittals shall be combined into a comprehensive package and submitted under this section heading.

B. Control Drawings: Schematic drawings, points lists, and sequences for controls included in this project.

1. System architecture diagram showing the communications wiring topology, model number or designation of each communicating device (controller, workstation, server, etc) including the equipment controlled, location and designation of each enclosure containing one or more communicating devices, and connections to Third-Party controls.

2. Floor plans showing enclosure locations; locations of communications devices; locations of field devices not mounted in enclosures or on equipment (space temperature/humidity, duct static pressure, building static pressure, differential pressure, and/or pressure taps); routers, repeaters, and controller locations; workstations and/or server locations.

3. Schematic diagram of each controlled system/equipment showing point devices/interfaces with a point-naming scheme matching that used on the associated control enclosure wiring diagram, and keyed to product data.
4. Instrumentation list for each controlled system with each component of the system labelled in table format, showing component name, type of device, manufacturer, model number, and control device product data sheet number.
5. Enclosure layout and wiring diagram showing the DDC routers, panels, and controllers, gateways and interfaces to third-party controls, enclosure-mounted field devices, internal wiring and wiring to field devices, communications wiring connections, and power supply; all labeled and keyed to a bill of materials. Indicate points used and spares.
6. Written sequence of operation for each controlled system/equipment, expanded from that provided herein, detailing how the sequences will be programmed, including control details specific to the equipment provided. Include an object/point list showing expanded object description information.

1.5 CLOSEOUT SUBMITTALS

A. As-built versions of the control drawings along with digital copies of any files or floor plans. The Owner shall be free to use and reproduce these files in any manner they choose.
   1. Final implemented sequences of operation shall be provided by the contractor after completion of the functional performance testing.
   2. Floor plan record drawings indicating actual locations of enclosures and field devices.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (SEQUENCES)

3.1 GENERAL REQUIREMENTS

A. Sequences included herein are intended to be performance based. The contractor shall develop detailed logic programming that expands upon these sequences. Implementations providing the same functional result using different underlying logic will be accepted.

B. Contractor proposed sequences shall be included in the submittals for review by the engineer. The points list included herein shall be considered minimum. Provide all points and point types required to meet the functional intent of the specified sequences.

C. Contractor proposed sequences shall be an accurate narrative of how the logic will be programmed, and shall include all necessary details, time delays, offsets, clarifications, and/or proposed enhancements.

D. Sequences shall be written with a logical and organized format with full outline numbering. Language shall be detailed, clear, and unambiguous. Point descriptors and point nomenclature referenced in the sequences shall match those on the drawings.

E. Programming bugs, due to misinterpretation and/or sequence errors, shall be corrected, and any changes required to provide proper system operation consistent with the design intent, shall be provided at no additional cost to the project.

F. Verification of conformance to the specified sequences will be through functional performance tests that demonstrate proper implementation.

3.2 COMMON REQUIREMENTS

A. The term "control loop" is used generically. When these are PID loops, proportional plus integral plus derivative gains are not required on all loops. Use proportional only loops for limiting (such as CO2). Do not use the derivative term unless field tuning is not possible without it.

1. Unless otherwise indicated, control loops shall be enabled and disabled based on status of the system being controlled to prevent windup.
2. When a control loop is enabled or re-enabled, it and all its constituents (proportional and integral terms) shall be set to a neutral value.
3. A control in neutral shall correspond to a condition that applies the minimum control effect (valve/dampers closed, drives at minimum speed, etc).
4. The contractor shall apply appropriate elements of gain to each PID loop, which will result in stable operation and minimum settling time.
5. The contractor shall find the timing of each process and use ramp functions to give the controlled variable time to respond and prevent two-positioning of modulating devices.

B. The term “proven” shall mean that the equipment’s binary status point matches the state set by the equipment’s binary command point. Motor status points shall be confirmed via motor current sensors, unless noted otherwise.

1. Monitoring motor current may be done in two ways: using a current sensor with analog output or using a current switch. A switch is assumed in sequences.
2. Current switches used for proving fan or pump status shall be setup so that they will detect belt or coupling loss by a reduction in current draw.
3. Electrically commutated motors monitored with an adjustable current switch shall calibrate the trip-point to be set just above the stand-by current.
4. Electrically commutated motors with manufacturer's fault contacts may be used to monitor motor status if available.

C. All setpoints, timers, deadbands, etc listed in sequences shall be adjustable by the user from the graphics (with appropriate security access) whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programming except for physical constants and conversion factors.

D. Any setpoint required to be reset shall use a cascaded PID loop, or Trim and Respond logic (every 'X' minute increment/decrement by 'Y' algorithm) only. The contractor shall tune these reset loops to provide stable control. Fixed reset schedules are not permitted unless specifically noted otherwise.

E. Duct static pressure setpoints for variable air volume systems shall be reset based on zone damper position, and supply air temperature setpoints shall be reset based on zone cooling or heating control loop output. Delay implementation at air handlers for 5-min after the unit starts.

F. When an operator starts the main component (fan, boiler, chiller, etc) of a system (air handling unit, water plant, etc) by a manual method (motor starter HOA) the BAS will execute the described sequence based on sensing motor operation via the status input.

G. All binary output points shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.

H. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change.

I. Where any sequence or schedule calls for more than one motor to start simultaneously, start commands shall be staggered by 5-sec intervals to minimize inrush current.

J. All safeties shall be hard-wired. None of the safety sequences described below shall be implemented with software interlocks, unless specifically noted otherwise.

K. Accumulate and store runtime hours for binary points. The user shall have the capability to define runtime totalization service alarms at regular intervals directly from the user interface.

L. Where high/low alarms are indicated, establish setpoint values that will alarm "out-of-range" device or sequence failures without creating nuisance trips.

M. All alarm points, including fault codes received thru a network interface, shall be converted and displayed in plain English text on the applicable graphic.

N. Include a sequence at each applicable controller to open two-position heating valves whenever the heating plant is disabled and the heating water pumps are stopped.

O. Where control valves are supplied to fail in the last position, include a sequence at each applicable controller to exercise valves fully, once per week during the off-season months.

P. The analog output sent to variable speed or modulating equipment (drives, boilers, etc) shall be configured such that 0% corresponds to off and 100% corresponds to the maximum speed/rate configured. The minimum speed/rate setting shall be a value greater than 0%.

Q. Actuator position may be assumed to be equal to the analog signal. Where floating point actuators are permitted, provide analog input position feedback.

R. The terms "adjustable points, "user definable points", or other terms to this affect shall indicate points that shall be adjustable by the operator directly from the operator interface (with appropriate access level control), without having to use the configuration tool.

3.3 TRENDING AND ARCHIVING

A. Trends shall be exposed BACnet trend objects. All physical points, virtual points, and calculated values in the system shall be sampled at the local controller and available for historical archiving at the server.

B. All indicated points shall be trended at "change of value" or time intervals and stored for a minimum of one year, unless otherwise noted.

C. Binary points shall be trended at "change of value". Analog points shall be trended at no more than 5-min intervals, except as noted otherwise. Critical points shall be trended as follows:

1. Air temperatures being reset shall be trended at COV for every 1.0F of change.
2. Water temperatures being reset shall be trended at COV for every 2.0F of change.
3. Plant equipment modulation rates shall be trended at COV for every 2.5% of change.

3.4 MORNING WARM-UP

A. An adaptive optimum start algorithm shall be used to minimize the warm-up time during the unoccupied mode necessary to achieve zone occupied temperature setpoint by the start of the scheduled occupied mode. Optimum start shall reside at the zone level, with “requests” passed up to the system level.

B. The controller shall calculate the required warm-up time based on the zone’s occupied heating setpoint, the current zone temperature, the outdoor air temperature, and a mass/capacity factor for each zone. The mass factor shall be manually adjusted or self-tuned by the BAS.

C. Where an air handler supplies multiple zones, warm-up shall start based on the zone requests or zone group with the longest calculated warm-up time requirement, but no earlier than 3-hours before start of the scheduled occupied period.

D. The supply air temperature shall be the warmest value of the occupied heating sequence. Where an air handler supplies multiple zones with reheat, the supply air temperature shall be no higher than the average space temperature setpoint.

E. Mixed air dampers shall be positioned closed to the outside air and open to the return air during warm-up mode. Relief dampers shall be closed and exhaust fans shall be off.

F. Optimum stop is not permitted. Morning cool-down is also not permitted, unless an economizer pre-cooling sequence is specifically indicated.

3.5 MIXED AIR DAMPERS

A. Mixed air dampers refer to the outside air damper and the return air damper. Unless detailed or indicated otherwise, they shall be supplied with independent outputs. The return air damper shall modulate in inverse proportion to the outside air damper.

B. When necessary the contractor shall include a secondary control loop to modulate the return air damper closed so that the outside air damper is able to provide the minimum outside air setpoint. Coordinate with the test and balance contractor.

C. Mixed air dampers shall remain closed to the outside air and open to the return air during the unoccupied mode, morning warm-up, optimal start periods, and when outside air temperature is below a low limit condition (where specified in sequences).

D. Whenever the unit is started in the occupied mode and outside air temperature is less than 40°F, implement a ramp function to prevent a change in the outside air damper position of more than 10% per minute.

E. Where a dedicated minimum outside air damper is installed, it shall modulate in series with the economizer damper as the first step in providing additional outside air, but shall not modulate below that needed to provide minimum outside air, unless overridden by safeties.

3.6 STAGING AND ROTATION

A. Lead/Lag: Parallel devices that are not redundant shall be lead/lag alternated so that the device with the least number of runtime hours is made the earlier stage device and the device with the most operating hours is made the later stage device.

B. Lead/Standby: Parallel devices that are redundant shall be lead/standby alternated so that the device with the least number of runtime hours is made the earlier stage device and the device with the most operating hours is made the later stage device.

C. If devices run continuously, the lead device shall switch at an operator-specified runtime. Provide ramped sequences for rotation of lead designated equipment such that systems or equipment will not be caused to fail.

D. In Alarm: If the lead device has a fault condition or has been manually switched off, a critical alarm shall be generated, and the device shall be set to the last stage position in the rotation order until the alarm is satisfied. Staging position of remaining devices shall follow the prevailing logic. A device in alarm will respond if called to run only if capable of doing so.

E. Hand Operation: If a device is manually started in hand (via an HOA switch or local control of a variable speed drive), the device shall be designated the lead device and a non-critical alarm shall be generated. The device will remain as the lead until automatic operation is restored by the operator.

3.7 TRIM AND RESPOND

A. Where referenced in sequences, trim and respond setpoint reset logic and zone/system reset requests shall be implemented as follows.

1. A “request” is a call to reset a pressure, temperature, or other variables at an air handler or central plant, generated by downstream zones or systems.
    a. Requests are sent upstream to the system or plant that serves the zone or air handler that generated the request.
    b. See zone and air handling system control sequences for additional logic used to generate requests.
2. An “importance multiplier” is used to scale the number of requests the zone/system is generating.
    a. A value of zero causes the requests from that zone or system to be ignored.
    b. A value greater than one can be used to increase the number of requests from the zone/system based on the critical nature of the spaces served.
    c. Importance multipliers for each zone or system shall be adjustable directly from the Operator Interface.
3. Multiply the number of requests determined from zone/system logic times the Importance Multiplier and send to the system/plant that serves the zone/system. See system/plant logic to see how requests are used in trim and respond logic.

4. For each upstream system or plant setpoint being controlled by a trim and respond loop, define the following variables. Initial values are listed in system/plant sequences. Values for trim, respond, time step, etc, shall be tuned to provide stable control.
    a. Time delay and time step.
    b. Initial setpoint, minimum and maximum setpoints.
    c. Number of requests and number of ignored requests.
    d. Trim amount, respond amount, and maximum response per time interval.
5. Rogue Zones: Provide a method of identifying zones/systems that are driving the reset logic. The contractor shall provide time and expense in the bid to identify rogue zones during the warranty period and assist the design team with adjustments, without additional cost to the project.

B. Terminal Unit System Requests:

1. Temperature Reset Requests:
    a. If the cooling loop is less than 95%, send 0 Requests,
    b. Else if the cooling loop is greater than 95%, send 1 Request until less than 85%,
    c. Else if zone temperature exceeds the cooling setpoint by 2°F for 2-min (after suppression period due to setpoint change), send 2 Requests,
    d. Else if zone temperature exceeds the cooling setpoint by 4°F for 2-min (after suppression period due to setpoint change), send 3 Requests.
2. Static Pressure Reset Requests:
    a. If the damper position is less than 95%, send 0 Requests,
    b. Else if damper position is greater than 95%, send 1 Request until less than 85%,
    c. Else if measured airflow is less than 75% of setpoint while setpoint is greater than zero and damper position is greater than 95% for 1-min, send 2 Requests,
    d. Else if measured airflow is less than 50% of setpoint while setpoint is greater than zero and damper position is greater than 95% for 1-min, send 3 Requests.

3.8 GENERIC THERMAL ZONES

A. Temperature Setpoints:

1. Each thermal zone shall have operator definable, independent occupied and unoccupied heating and cooling temperature setpoints separated by a deadband. The active setpoints shall be determined by the operating mode of the Zone Group.
    a. Occupied heating setpoints shall be 70°F, unless noted otherwise.
    b. Occupied cooling setpoints shall be 74°F, unless noted otherwise.
    c. Unoccupied heating setpoints shall be 65°F.
    d. Unoccupied cooling is not permitted.

2. Where zones have local setpoint adjustment, the offsets established by the occupant shall be software points that are persistent (not reset daily), subject to limits described below. Local setpoint adjustments shall be in whole number increments, and only effective in the occupied mode. Confirm range limits with owner.
    a. Absolute Limits: The occupied heating setpoint shall be limited to a maximum of 72°F, and the occupied cooling setpoint shall be limited to a minimum of 72°F.
    b. Anti-Overlap: The software shall prevent the heating and cooling setpoints from exceeding the deadband.
3. Activation of a local timed override shall index associated equipment to the occupied mode for an initially programmed period of 2-hrs. Associated equipment includes all equipment in the zone group, all related relief/exhaust sequences, and time-scheduled area exhaust.
4. The active heating and cooling setpoints shall be independently adjustable, respecting limits and anti-overlap logic described above. Local setpoint adjustment shall not display a user setpoint that is not attainable.
5. If the vendors zone thermostat provides only a single setpoint adjustment, then the setpoint shall be the center of the deadband and the adjustment shall move both the active heating and cooling setpoints upwards or downwards by the same amount, within the limits described above.
6. For zones that have an occupancy switch: Not applicable.
7. For zones that have a window switch: Not applicable.

B. Control Loops:
1. Separate heating and cooling control loops shall operate to maintain space temperature at setpoint. The operating state (heating, cooling, deadband, etc) shall be displayed on the graphics.
2. The heating loop shall be enabled whenever space temperature is below the current zone heating setpoint temperature, and disabled when space temperature is above the current zone heating setpoint temperature and loop output is zero for longer than 30-sec.
    a. The heating loop shall maintain the space temperature at the active heating setpoint.
    b. The output of the loop shall be a virtual point ranging from 0% (no heating) to 100% (full heating).
3. The cooling loop shall be enabled whenever space temperature is above the current zone cooling setpoint temperature, and disabled when space temperature is below the current zone cooling setpoint temperature and loop output is zero for longer than 30-sec.
    a. The cooling loop shall maintain the space temperature at the active cooling setpoint.
    b. The output of the loop shall be a virtual point ranging from 0% (no cooling) to 100% (full cooling).
4. Loops shall use PID or other logic with similar performance. Proportional-only control is not acceptable, although integral gain will be small relative to proportional gain. Proportional and integral gains shall be adjustable by an operator with appropriate security access.

C. Zone Groups:

1. Zone groups are sets of zones served by a single air handler that operate together for ease of scheduling and/or to ensure sufficient load to maintain stable operation of upstream equipment.
    a. Each system shall be broken into zone groups composed of a collection of one or more zones served by a single air handler.
    b. Each zone group shall be capable of having separate occupancy schedules and operating modes from other zone groups.
2. All zones in each zone group shall be in the same operating mode at all times.
    a. If one zone is placed in any mode other than unoccupied, due to override, sequence logic, or occupancy schedule, all zones in that zone group shall enter the same mode.
    b. A zone group shall be in only one mode at any given time.
3. Follow current IECC requirements for determining zone groups. At a minimum each floor level served by each air handler shall be its own zone group. Consult the owner for all other group assignments and scheduling.

D. Setback Mode: During unoccupied mode, if any five (adj) zones in the zone group (or all zones if fewer than five) fall below their unoccupied heating setpoints, or if the average zone temperature of the zone group falls below the average unoccupied heating setpoint, the zone group shall enter setback mode until all spaces are 2°F above their unoccupied setpoint.

3.9 ALARMS

A. Alarm Levels:
1. Configure a minimum of four levels of alarm, even if some levels are not used for this project. Levels shall be configured as follows:
    a. Level 1: Life Safety Alarms
    b. Level 2: Critical Hvac Alarms
    c. Level 3: Non-Critical Hvac Alarms
    d. Level 4: Maintenance Notifications
2. Consult with the Owner to determine and agree upon final categorizing and notification outputs of all system alarms.
    a. Critical alarms shall include water and air temperatures not meeting setpoint.
    b. Non-critical alarms shall include any point reaching a high or low limit and any status or feedback that doesn't equal command.

B. Maintenance Mode: Operators shall have the ability to put any device in or out of maintenance mode.
1. All alarms associated with a device in maintenance mode will be suppressed. Life safety alarms shall not be suppressed.
2. When a device is in maintenance mode, issue a daily non-critical alarm (level 3) at a scheduled time indicating that the device is still in maintenance mode.

C. The operator may acknowledge both latching and non-latching alarms. Acknowledging clears the alarm, the exit deadband, and suppression period. A device may enter back into alarm as soon as the entry delay elapses.

3.10 ALARM SUPPRESSION

A. For each piece of equipment or space controlled by the BAS, define its relationship (if any) to other equipment in terms of source, load, or system.

1. A component is a “source” if it provides resources to a downstream component, such as a chiller providing chilled water to an air handler.
2. A component is a “load” if it receives resources from an upstream component, such as an air handler that receives chilled water from a chiller.
3. The same component may be both a load (receiving resources from an upstream source) and a source (providing resources to a downstream load), such as a pump.
4. A set of components is a “system” if they share a load in common (collectively act as a source to downstream equipment), such as a set of chillers in a lead/lag relationship serving air handlers).
5. If pumps are in a one-to-one relationship with equipment they serve, the pumps shall be treated as part of the system to which they are associated (not considered loads) since a pump failure will necessarily disable its associated equipment.
6. If pumps are headered to the equipment they serve, then the pumps may be treated as a system, which is a load relative to the upstream equipment (chillers) and a source relative to downstream equipment (air handlers).
7. Water temperature alarms are a source to air handlers. Air handler alarms are a source to terminal equipment and room temperatures. Fire alarms are a source to the associated equipment. Etc.

B. The BAS shall selectively suppress (fail to announce, but still log to a database) alarms for load components if the source that serves the load is already in alarm.

C. This hierarchical alarm suppression shall cascade through multiple levels of load-source relationships, such that alarms at downstream loads shall also be suppressed.

D. Life safety or critical alarms shall never be suppressed. Failure to start and failure to stop alarms shall not be suppressed.

E. Time-based suppression blocks shall calculate a time delay period after any change in setpoint based on the difference between the controlled variable at the time of the change and the new setpoint.The default time delay period shall be:

1. For zone temperature alarms: 10-min per °F of difference, not to exceed 120-min.
2. For zone temperature cooling requests: 5-min per °F of difference, not to exceed 30-min.
3. For zone temperature heating requests: 5-min per °F of difference, not to exceed 30-min.
4. For heating water temp alarms: 20-min delay upon initial activation of the plant.
5. For chilled water temp alarms: 20-min delay upon initial activation of the plant.

3.11 HARD-WIRED SAFETIES

A. All safety devices (smoke detectors or fire alarm fan shutdown relays, freeze stats or fire stats, pressure switches, low water cutoffs, flow switches, etc.) shall be hard-wired directly to the controlled equipment.

B. Low-Limit Freeze Stat:

1. Install an averaging type sensor downstream of the heating coil connected to a low-limit temperature switch. Wire in series with the safety circuit of the fan(s).

2. The freeze stat shall act independently of the system via hard-wire interlock and shall override the system control signal to open the heating coil control valve.

3. The switch shall be a manual reset type. Initial setpoint shall be 35°F. The BAS shall monitor status and generate an alarm.

C. Fan High Pressure Limit:

1. Install a static pressure probe located in the air handling unit main discharge duct at least 6-ft downstream of the fan and upstream of any dampers, and pipe to a differential pressure switch. Wire in series with the safety circuit of the fan(s).

2. The switch shall be a manual reset type. Initial setpoint shall be 25% higher than normal operating conditions, not to exceed 0.5-in w.c. less than the pressure class of the supply duct. The BAS shall monitor status and generate an alarm.

D. Fan Low Pressure Limit:

1. Install a static pressure probe located in the air handling unit immediately upstream of the filters (and/or return fan), and pipe to a differential pressure switch. Wire in series with the safety circuit of the fan(s).

2. The switch shall be a manual reset type. Initial setpoint shall be -2.0-in w.c. The BAS shall monitor status and generate an alarm.

E. Fire Alarm Shutdown:

1. Upon alarm, the fire alarm control module (provided by the electrical contractor) shall change the state and cause the fan unit to shut down, and all fire/smoke and smoke dampers in the system shall close.

2. Field wire an auxiliary contact from the appropriate fire alarm system control module to notify the BAS.

3.12 EMERGENCY POWER

A. When a loss of utility power is detected, the sequence of operations associated with all BAS controlled equipment electrically powered by the failed source shall be halted (PID loops shall not windup, equipment failure alarms shall be suppressed, start commands shall be retracted, other equipment failure modes shall not be initiated, etc).

1. When standby power is detected, the sequence of operations associated with all BAS controlled equipment fed by standby power shall be re-enabled following a 30-sec delay.

2. All seqquences shall be re-enabled and BAS controlled equipment restarted on staggered intervals over a 5-min period to reduce strain on the generator.
3. When a return of utility power is detected, all sequences shall be re-enabled and BAS controlled equipment restarted on staggered intervals over a 5-min period to minimize electrical in-rush current.

B. Provide a binary input point connected to an auxiliary dry contact in the standby power system's automatic transfer switch. Provide indication on the graphics home page.
1. If the associated Building Controller (B-BC) is powered by normal or emergency power, it may monitor its own power source as an indication of power status.
2. If the B-BC is powered by uninterruptible power supply (UPS), or if the B-BC is not capable of monitoring its own power for use in sequences, the contractor shall provide at least one current sensing relay per control panel.

3.13 SCHEDULES

A. Schedule all terminal equipment (at the zone level) and allow the calls for start to turn on the up-line equipment. Schedules shall reside in the zone controller and remain functional upon a loss of communication with the system.

B. Unoccupied schedules shall be programmed for weeknights, weekends, seasonal and holiday breaks. Consult with the Owner and program for a minimum of one calendar year.

3.14 SPECIFIC SEQUENCES

A. Sequences are performance based. The contractor shall develop detailed logic programming that expands on those listed herein. Sequences providing the same functional result using different underlying logic will be considered.

B. Loop Pumps:
1. See Subsection 25 9504 Chilled Water Loop Pumps.
2. See Subsection 25 9506 Heating Water Loop Pumps.

C. Chilled Water Plant:
1. See Subsection 25 9512 Air-Cooled Water Chillers.

D. Heating Hot Water Plant:
1. See Subsection 25 9528 Small Capacity Boilers.

E. Multiple Zone Units:
1. See Subsection 25 9532 Multiple Zone Air Handlers.

F. Room Units:
1. See Subsection 25 9562 Air Terminal Units.

G. Miscellaneous:
1. See Subsection 25 9598 Miscellaneous.

END OF SECTION

SECTION 25 9504 - CHILLED WATER LOOP PUMPS

1.1 CHILLED WATER SYSTEM PUMPS

A. Run Conditions:

1. The chilled water system shall be enabled to run whenever:
    a. Outside air temperature is greater than an adjustable setpoint (50°F initially).
    b. And at least one chilled water coil needs cooling.

B. Chilled Water System Pump:

1. The chilled water pump shall start prior to the chillers being enabled and shall stop only after the chillers are disabled.
2. The chilled water pump shall also run for freeze protection:
    a. Duty cycle the pump 2-min for each 30-min period when the outside air temperature is below 25°F (adj).
    b. The chilled water pump shall run continuously whenever an air handler freeze-stat is active.
3. Alarms shall be provided as follows:
    a. Pump Failure: Commanded on, but the status is off.
    b. Pump in Hand: Commanded off, but the status is on.
    c. Pump VSD Fault: Mfgr's hard-wired contacts.

C. Monitoring and Alarms:

1. VSD Interface: Variable speed drive status and operating conditions shall be monitored and trended by the BAS thru the drive's communications interface. Data shall be provided as follows:
    a. Motor speed, frequency, current, and runtime.
    b. Drive status, fault condition, and fault code.
    c. System flow rate (gpm).

D. Minimum Points List: (T = Trend, A = Alarm, G = Show on Graphics)

1. Binary Inputs:

CHW Pump Status	(1)	(T/G)
CHW Pump VSD Fault	(1)	(A/G)

2. Binary Outputs:

CHW Pump Enable	(1)	(T/G)

3. Analog Data:

Outside Air Temp	(1)	(T/G)

END OF SECTION

SECTION 25 9506 - HEATING WATER LOOP PUMPS

1.1 HEATING WATER SYSTEM PUMPS

A. Run Conditions:

1. The heating water system shall be enabled to run whenever:
    a. Outside air temperature is less than an adjustable setpoint (80°F initially).
    b. And a user definable number of heating water coil needs heating.

B. Heating Water System Pumps:

1. Two heating water pumps operate in a duty/standby configuration.
    a. The lead pump shall run first.
    b. On failure of the lead pump, the lag pump shall run.
2. The pump with the least accumulated runtime shall be the designated lead pump. The designated lead pump shall rotate weekly or manually thru a software switch.
3. A heating water pump shall start prior to the boilers being enabled and shall stop only after the boilers are disabled.
4. Alarms shall be provided as follows:
    a. Pump Failure: Commanded on, but the status is off.
    b. Pump in Hand: Commanded off, but the status is on.
    c. Pump VSD Fault: Mfgr’s hard-wired contacts.

C. Heating Water Differential Pressure Control:

1. The controller shall measure differential pressure at a minimum of three locations and modulate heating water pump speed to maintain the heating water differential pressure setpoint to satisfy the worst case condition.
2. Differential pressure setpoints shall be optimized in conjunction with the test and balance contractor, and adjusted during the warranty period to match actual field conditions.
3. Alarms shall be provided as follows:
    a. High HHW Differential Pressure: If 25% greater than setpoint for longer than 15-min.
    b. Low HHW Differential Pressure: If 25% less than setpoint for longer than 15-min.

D. Monitoring and Alarms:

1. VSD Interface: Variable speed drive status and operating conditions shall be monitored and trended by the BAS thru the drive's communications interface. Data shall be provided as follows:
    a. Motor speed, frequency, current, and runtime.

b. Drive status, fault condition, and fault code.

c. System flow rate (gpm).

E. Minimum Points List: (T = Trend, A = Alarm, G = Show on Graphics)

1. Analog Inputs:

HHW Differential Press	(3)	(T/G)

2. Analog Outputs:

HHW Pump Speed	(2)	(T/G)

3. Binary Inputs:

HHW Pump Status	(2)	(T/G)
HHW Pump VSD Fault	(2)	(T/G)

4. Binary Outputs:

HHW Pump Enable	(2)	(T/G)

5. Analog Data:

Outside Air Temp	(1)	(T/G)
HHW Diff Press Setpoint	(1)	(T/G)
HHW Pump Runtime	(2)	(T/G)

END OF SECTION

SECTION 25 9512 - AIR-COOLED WATER CHILLERS

1.1 AIR-COOLED WATER CHILLERS

A. Run Conditions:

1. The chiller plant shall be enabled to run whenever a chilled water system pump has been proven on for longer than 1-min.
2. The chiller shall run subject to its own internal safeties and controls. This contractor shall provide field wiring of chiller safeties or other devices, per the manufacturer's instructions.
    a. Flow switch (field wired).
3. To prevent short cycling, chillers shall run for and be off for minimum adjustable times, unless shutdown on safeties.

B. Air-Cooled Scroll Chiller:

1. An equipment integrated chiller control will modulate the chiller to maintain chilled water temperature at setpoint (subject to operating limits).
2. This contractor shall hard-wire the start/stop, setpoint signal, and master alarm.
3. The chiller controls will be setup to operate per the chiller manufacturer.
4. Alarms shall be provided as follows:
    a. Chiller General Alarm: Manufacturer's hard-wired contacts.

C. Chilled Water Supply Temperature Setpoint:

1. The controller shall measure chilled water supply temperature and reset the setpoint from 44°F to 50°F (adj) to maintain at least one chilled water coil valve 95% open.
    a. The reset shall use a PID loop or trim and respond function based on cooling requirements. Do not use a fixed reset schedule.
    b. Do not reset the chilled water supply temperature setpoint above that which prevents any chilled water coil control loop from being satisfied.
    c. External chilled water supply temperature reset shall be a hard-wired point.
2. The contractor shall trend the operation of this sequence during the warranty period to adjust the reset function and maximum setpoint value so that it is as high as possible without loss of temperature control.

D. Glycol Tank/Pump:

1. The controller shall monitor alarm contacts at the glycol tank/pump unit.
2. Alarms shall be provided as follows:
    a. Glycol Tank/Pump Failure: Manufacturer's hard-wired contacts.

E. Monitoring and Alarms:

1. Temperature: The controller shall monitor system chilled water supply and chilled water return temperatures, and use as required for control. Alarms shall be provided for out-of-range conditions (only when chiller plant control is active).

F. Chiller Controller Interface:

1. The chiller is supplied with equipment integrated operating and safety controls, and a BACnet interface (confirm via submittals). Provide graphic display, status monitoring, data trending, and alarm notification.

2. The following data shall be monitored and trended by the BAS thru the chillers integrated interface. Read-only and/or read/write data shall be mapped into the BAS as follows:

   a. Submit a manufacturer's list of available points.

   b. Provide for a minimum of 24 data points.

G. Minimum Points List: (T = Trend, A = Alarm, G = Show on Graphics)

1. Analog Inputs:

CHW System Supply Temp	(1)	(T/G)
CHW System Return Temp	(1)	(T/G)

2. Analog Outputs:

External CHWS Reset	(1)	(T/G)

3. Binary Inputs:

Chiller General Alarm	(1)	(A/G)
Glycol Tank/Pump Fault	(1)	(A/G)

4. Binary Outputs:

Chiller Enable	(1)	(T/G)

5. Analog Data:

Outside Air Temp	(1)	(T/G)
CHWS Temp Setpoint	(1)	(T/G)
Chiller Runtime	(1)	(G)

6. Chiller Interface:

   To be determined

END OF SECTION

SECTION 25 9528 - SMALL CAPACITY BOILERS

1.1 MOD-CON BOILERS

A. Run Conditions:

1. The heating water boiler plant shall be enabled to run whenever a heating water system pump has been proven on for longer than 1-min.
2. Each boiler shall run subject to its own internal safeties and controls. This contractor shall provide field wiring of boiler safeties or other devices, per the manufacturer's instructions.
    a. Gas pressure switches (factory wired).
    b. Low water cutoff (field wired).
    c. Flow switch (factory wired).

B. Heating Water Boilers:

1. Four heating water boilers shall operate in a lead/lag configuration. An equipment integrated boiler controller will modulate the boilers to maintain heating water supply temperature at setpoint (subject to operating/flow limits).
2. Boiler controls and accessory devices will be setup to operate per the equipment manufacturer. Staging, lead/lag, rotation, firing rates, etc, will be by the manufacturer's "master" boiler controller.
3. This contractor shall hard-wire the cascade between all boilers, the master alarm from each boiler, the enable signal and setpoint signal to boiler B1, and a manufacturer's header temp sensor to boiler B1.
4. The heating water supply temperature shall be setup to reset from 110°F to 150°F (adj) as the outside air temperature varies from 65°F to 25°F (adj).
5. The back-up heating water boiler (B2) shall have the same wiring installed as the master heating water boiler (B1), but not terminated. Upon failure of the master boiler, the owner need only to swap wiring terminations at the master boiler and back-up boiler.
6. Alarms shall be provided as follows (each boiler):
    a. Boiler General Alarm: Manufacturer's hard-wired contacts.

C. Boiler Circulation Pumps:

1. Each dedicated boiler heating water circulation pump is controlled by its respective boiler for start/stop and run-on delay.
2. This contractor shall hard-wire the enable interlocks between the boilers and their respective boiler circulation pumps. Install relays where needed.
3. Alarms shall be provided as follows:
    a. Boiler Pump Fault: Manufacturer's hard-wired contacts.

D. Monitoring and Alarms:

1. Temperature: The controller shall monitor system heating water supply and system heating water return temperatures, and use as required for control. Alarms shall be provided for out-of-range conditions (only when heating plant control is active).

E. Boiler Controller Interface:

1. Each boiler is supplied with equipment integrated operating and safety controls, and a BACnet interface (confirm via submittals). Wire the interface and provide graphic display, status monitoring, data trending, and alarm notification.

2. The following data shall be monitored and trended by the BAS thru each boilers integrated interface. Read-only data shall be mapped into the BAS as follows:

   a. Boiler status code, firing rate, inlet temp, and outlet temp.

   b. Boiler cycle count, runtime hours, and error code.

   c. Boiler pump state and speed.

F. Minimum Points List: (T = Trend, A = Alarm, G = Show on Graphics)

1. Analog Inputs:

HHW Supply Temp	(1)	(T/G)
HHW Return Temp	(1)	(T/G)

2. Analog Outputs:

Heating Plant Setpoint	(1)	(T/G)

3. Binary Inputs:

Boiler General Alarm	(4)	(A/G)
Boiler Pump Fault	(4)	(A/G)

4. Binary Outputs:

Boiler Plant Enable	(1)	(T/G)

5. Analog Data:

Outside Air Temp	(1)	(T/G)
HHW Supply Temp Setpoint	(1)	(T/G)

6. Boiler Interface:

   To be determined

END OF SECTION

SECTION 25 9532 - MULTIPLE ZONE AIR HANDLERS

1.1 MULTIPLE ZONE VARIABLE VOLUME AIR HANDLERS

A. Run Conditions:

1. Occupied: The unit shall run whenever any zone or zone group is indexed to an occupied or optimal start mode.
2. Unoccupied: The unit shall run as necessary to satisfy a user definable number of zone heating requests at the terminal unit control level.
    a. The supply fan shall operate under normal fan control. The relief fan shall remain off.
    b. The unit shall run for a minimum of 30-min or until there are no zone heating requests.

B. Safeties:

1. The unit shall shut down and generate an alarm upon receiving any of the following:
    a. Freeze-stat low-limit status (downstream of the heating coil).
    b. High static shutdown signal (discharge of the supply fan).
    c. Low static shutdown signal (suction of the supply fan).
    d. Smoke detector status (supply air and/or return air at the unit).
2. Monitor status of each safety and send an alarm to the Operator Interface.

C. Unit Optimal Start:

1. Optimal start is at the zone level. The unit shall start prior to scheduled occupancy based on a definable number of requests from any of its associated terminal unit controllers with zone level optimal start.
2. Start time shall atomatically adjust based on changes in outdoor air temperature and zone temperatures.

D. Supply Fan:

1. The controller shall modulate multiple equally sized direct-drive plenum supply fans controlled with multiple variable frequency controllers.
    a. The fans shall shall run anytime the unit is commanded to run, unless shutdown on safeties.
    b. To prevent short cycling, there shall be a user definable delay between fan stages, and each stage shall have a user definable minimum runtime.
2. The controller shall sum the terminal unit airflow rates served by the unit to a software point, and display a supply airflow rate total on the graphics page. Trend this point.
3. Alarms shall be provided as follows:
    a. Supply Fan Failure: Commanded on, but the status is off.

b. Supply Fan in Hand: Commanded off, but the status is on.

c. Supply Fan VSD Fault: Mfgr's hard-wired contacts (where no interface is used).

E. Supply Air Duct Static Pressure Control:

1. The controller shall measure duct static pressure at a minimum of three locations and modulate supply fan speed to maintain the duct static pressure setpoint at the lowest sensor reading location.

a. Delay this sequence until fan status has been proven on for 5-min.

b. Identify the controlling sensor location and trend this point.

2. The duct static pressure setpoint shall be reset using trim and respond logic within the range of 0.50-inches w.c. to P-max (both adj) as follows:

a. The initial duct static pressure setpoint shall be 0.75-inches w.c. (adj). Every 2-min, trim the setpoint -0.04-inches.

b. When there are one or more pressure requests (adj), respond by +0.06-inches times the number of requests, not to exceed 0.15-inches per interval.

c. A pressure request is generated when any zone damper served by the system is 95% open, until it drops to 85% open.

3. The maximum static pressure setpoint (P-max) shall be adjusted to a design day cooling value (determined in conjunction with the test and balance contractor).

4. The drive speed shall not drop below a minimum setpoint (determined in conjunction with the test and balance contractor, subject to mfgr limits).

5. The contractor shall trend operation of this sequence during the warranty period. Values for trim, respond, time step, requests, etc shall be tuned to provide stable control.

6. The contractor shall implement logic to identify rogue zones during the warranty period, and work with the engineer to make adjustments as necessary.

7. Alarms shall be provided as follows:

a. High SA Static Press: If 0.25-inches greater than setpoint for longer than 10-min.

b. Low SA Static Press: If 0.25-inches less than setpoint for longer than 10-min.

F. Relief Dampers:

1. The relief air dampers shall be enabled whenever:

a. The supply fan status is on in an occupied mode.

b. And the economizer damper position is greater than 10% open (adj).

2. The relief damper shall open prior to the relief fan being enabled and shall close only after the fan is disabled. An integral damper end switch shall prove damper position.

3. Alarms shall be provided as follows:

a. Damper Failure: Commanded open, but the status is closed.

G. Relief Fans:

1. The relief fans shall be enabled to run whenever:

a. The supply fan is on in an occupied mode.

b. And the relief damper is proven open.

2. The relief fan speed shall not drop below a minimum setpoint (determined in conjunction with the test and balance contractor, subject to limits).

3. Alarms shall be provided as follows:

a. Relief Fan Failure: Commanded on, but the status is off.

b. Relief Fan in Hand: Commanded off, but the status is on.

c. Relief Fan VSD Fault: Mfgr's hard-wired contacts.

H. Space Static Pressure Control:

1. The controller shall measure space static pressure and stage the relief dampers in series with modulating relief fans to maintain a space static pressure setpoint of 0.05-in wc.

a. The relief dampers shall open when the space static pressure rises above 0.03-in (adj) and close when space static pressure falls below 0.01-in (adj).

b. The relief fans shall be staged on and modulate when space static pressure rises above 0.05-in (adj), and be stage off when pressure falls below 0.03-in (adj).

c. Three relief dampers and three relief fans shall be controlled in unison (with the ability to run the relief fans in a lead/lag fashion if necessary).

2. Space static pressure shall be time averaged with a sliding 5-min window and 15-sec sampling rate to dampen fluctuations. The average value shall be displayed and used for control.

3. The drive speeds shall not drop below a minimum setpoint (determined in conjunction with the test and balance contractor, subject to mfgr limits).

4. Alarms shall be provided as follows:

a. High Space Static Press: If greater than 0.10-in wc for longer than for 15-min.

b. Low Space Static Press: If less than 0.00-in wc for longer than for 15-min.

I. Supply Air Temperature Setpoint:

1. The controller shall measure the supply air temperature and maintain a supply air temperature setpoint based on zone cooling requirements.

2. The supply air temperature setpoint shall be reset using trim and respond logic within the range of 56°F to 68°F (adj) as follows:

a. The initial supply air temperature setpoint shall be 60°F (adj). Every 2-min, trim the setpoint +0.2°F.

b. When there are two or more cooling requests (adj), respond by decreasing the setpoint -0.3°F times the number of requests, not to exceed 1.0°F per interval.

c. A cooling request is generated when the cooling loop of any zone served by the system is greater than 95% until it falls to 85%.

3. The supply air temperature setpoint shall be 70°F (adj) during morning warm-up and unoccupied night setback.

4. The contractor shall trend operation of this sequence during the warranty period. Values for trim, respond, time-step, requests, etc shall be tuned to provide stable control.

J. Cooling Coil Valve:

1. The controller shall measure the supply air temperature and modulate the cooling coil valve to maintain its cooling setpoint.
2. The cooling coil valve shall be enabled whenever:
    a. Outside air temperature is greater than 50°F.
    b. And the economizer is disabled or fully open.
    c. And the supply fan status is on.
    d. And heating is not active.
3. The cooling coil valve shall open to 50% whenever:
    a. The freeze-stat status is on.
4. Alarms shall be provided as follows:
    a. High Supply Air Temp: If 5°F greater than setpoint for longer than 15-min, when the cooling control loop is active.

K. Heating Coil Valve:

1. The controller shall measure the supply air temperature and modulate the heating coil valve to maintain its heating setpoint.
2. The heating coil valve shall be enabled whenever:
    a. Outside air temperature is less than 70°F.
    b. And the supply fan status is on.
    c. And cooling is not active.
3. The heating coil valve shall open fully whenever the freeze-stat status is on.
4. The heating coil valve shall modulate to maintain a 60°F mixed air temperature whenever the supply fan status is off and the outside air temperature is less than 40°F.
5. Alarms shall be provided as follows:
    a. Low Supply Air Temp: If 5°F less than setpoint for longer than 15-min, when the heating control loop is active.

L. Economizer:

1. The controller shall measure the mixed air temperature and modulate the mixed air dampers in sequence to maintain a mixed air setpoint 2°F less than the supply air temperature setpoint.
2. The economizer shall be enabled whenever:
    a. Outside air temperature is less than return air temperature.
    b. And outside air temperature is less than 65°F.
    c. And supply fan status is on in an occupied mode.

d. And heating has not been active for at least 5-min.

3. The economizer shall close whenever:

a. The supply fan status is off.

b. Or the freeze-stat status is on.

c. Or mixed air temperature drops from 45°F to 40°F.

M. Minimum Outside Air Control:

1. The controller shall measure the outside airflow via third party thermal dispersion device and modulate a dedicated minimum outside air damper to maintain the minimum outside airflow setpoint.

2. The outside air damper shall be overridden to less than the minimum position to maintain a mixed air low limit condition of 40°F (adj).

N. Filter Differential Pressure:

1. The controller shall measure differential pressure across the filters and indicate filter condition.

2. Filter differential pressure setpoint shall vary with total airflow as follows:

a. Filter DP Setpoint = (Measured Supply CFM/Design CFM)^1.4 x Design Dirty Filter DP.

3. Alarms shall be provided as follows:

a. Filter Change Required: Filter differential pressure exceeds a user definable limit.

O. Monitoring and Alarms:

1. Temperature: The controller shall monitor supply air, mixed air, and return air temperatures, and use as required for control. Alarms shall be provided for out-of-range conditions for each.

2. Operating Modes: Provide indication of various operating states on the graphics.

a. Operating Mode (occupied vs unoccupied).

b. Conditioning Mode (cooling vs heating vs deadband).

3. VSD Interface: Variable speed drive status and operating conditions shall be monitored and trended by the BAS thru the drive's communications interface. Data shall be provided as follows:

a. Motor speed, frequency, current, and runtime.

b. Drive status, fault condition, and fault code.

P. Air Terminal Unit Interface:

1. Variable volume terminal units served by the air handler shall be interfaced with the AHU controller to perform the following functions:

a. Zone occupancy: receive requests for occupied/unoccupied operating modes and optimal start of the air handling unit.

b. Duct static pressure reset: as defined under supply air duct static pressure control above (with pressure requests from the zone level).

c. Supply air temperature reset: as defined under supply air temperature control above (with temperature requests from the zone level).

Q. Minimum Points List (each): (T = Trend, A = Alarm, G = Show on Graphics)

1. Analog Inputs:

Supply Air Temp	(1)	(T/G)
Mixed Air Temp	(1)	(T/G)
Return Air Temp	(1)	(T/G)
SA Duct Static Press	(3)	(T/G)
Bldg/Space Static Press	(1)	(T/G)
Outside Airflow	(1)	(T/G)
Filter Differential Press	(2)	(T/G)

2. Analog Outputs:

Supply Fan Speed	(1)	(T/G)
Relief Fan Speed	(1)	(T/G)
Cooling Coil Valve	(1)	(T/G)
Heating Coil Valve	(1)	(T/G)
Min Outside Air Damper	(1)	(T/G)
Econ Outside Air Damper	(1)	(T/G)
Return Air Damper	(1)	(T/G)

3. Binary Inputs:

Supply Fan Status	(2)	(T/G)
Relief Fan Status	(3)	(T/G)
Relief Damper Status	(3)	(T/G)
Freeze-Stat Low Limit	(1)	(A/G)
High Static Shutdown	(1)	(A/G)
Low Static Shutdown	(1)	(A/G)
Smoke Detector	(1)	(A/G)
Supply Fan VSD Fault	(2)	(A/G)
Relief Fan VSD Fault	(3)	(A/G)

4. Binary Outputs:

Supply Fan Enable	(2)	(T/G)
Relief Fan Enable	(3)	(T/G)
Relief Air Damper	(3)	(T/G)

5. Analog Data:

Outside Air Temp	(1)	(T/G)
Total Supply Airflow	(1)	(T/G)
SA Static Press Setpoint	(1)	(T/G)
Space Static Press Setpoint	(1)	(T/G)
Supply Air Temp Setpoint	(1)	(T/G)
Mixed Air Temp Setpoint	(1)	(T/G)
Outside Airflow Setpoint	(1)	(T/G)
Filter Diff Press Setpoint	(2)	(T/G)

END OF SECTION

SECTION 25 9562 - AIR TERMINAL UNITS

1.1 AIR TERMINAL UNITS

A. Run Conditions:

1. The unit shall run according to an operator definable time schedule.
    a. Occupied heating and cooling setpoints shall be 70°F and 74°F respectively.
    b. Unoccupied heating setpoint shall be 65°F. Unoccupied cooling is not permitted.
2. Alarms shall be provided as follows:
    a. High Zone Temp: If zone temperature is 5°F greater than setpoint for 30-min.
    b. Low Zone Temp: If zone temperature is 5°F less than setpoint for 30-min.

B. Zone Setpoint:

1. Unless otherwise indicated, the occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
2. A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time.

C. Zone Optimal Start:

1. The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up period while still achieving comfort conditions by the start of the scheduled occupied period. The optimal start request shall be passed up-line to the corresponding air handler.

D. Terminal Unit Control:

1. The controller shall measure zone temperature and maintain setpoint by modulating the terminal unit zone damper and the reheat coil as follows:
    a. When zone temperature is greater than the cooling setpoint (zone state is cooling), the cooling loop output shall reset primary airflow from the minimum occupied airflow (adj) to the maximum scheduled cooling airflow (adj), while the reheat coil is positioned for no heating.
    b. When zone temperature is between the cooling setpoint and the heating setpoint (zone state is deadband), the active airflow setpoint shall be the minimum occupied setpoint (adj), while the reheat coil remains positioned for no heating.
    c. Where pinch-off units are indicated, when zone temperature is less than the heating setpoint (zone state is heating), the heating loop output shall modulate the reheat coil and zone damper in sequence as follows:
        1) Stage 1 (heating loop output 0-50%): Modulate the reheat coil to provide heating with a 95°F (adj) upper limit, while the zone damper is positioned to maintain the minimum airflow.

2) Stage 2 (heating loop output 51-100%): Modulate the zone damper to reset airflow from the minimum to the maximum scheduled heating airflow (adj), while modulating the reheat coil to maintain the discharge air temperature limit.

3) If heat is not available (boilers locked out or discharge air temperature is less than zone temperature), stage two heating shall be disabled to prevent over-cooling.

2. During unoccupied setback and morning warm-up periods:

a. Where there's no call for heat, the zone damper shall be positioned to 20% open and the reheat coil shall be positioned for no heating.

b. On a call for heat, the zone damper shall open to the scheduled heating airflow and the reheat coil valve shall open to provide maximum heat.

c. Unoccupied setback shall use a 3°F drift to prevent over-cycling or continuous operation of the air handler during the unoccupied mode.

E. Reheat Coil Valve:

1. The reheat coil valve shall be enabled whenever zone temperature is less than setpoint.

2. During unoccupied setback or morning warm-up periods, the controller shall suspend the discharge air temperature limit for quickest recovery.

F. Monitoring and Alarms:

1. Temperature: The controller shall monitor discharge air temperature, and use as required for control. Alarms shall be provided for out-of-range conditions.

2. Operating Modes: Provide indication of various operating states on the graphics.

a. Operating Mode (occupied vs unoccupied).

b. Conditioning Mode (cooling vs heating vs deadband).

3. Provide indication of scheduled minimum and maximum airflow setpoints on the graphics.

G. AHU/Plant Interface:

1. The controller shall send requests for occupied/unoccupied operating modes and optimal start of the associated air handling unit.

2. The controller shall send supply air temperature and static pressure reset requests upstream to the source air handler.

3. System requests shall be configured as described in these specifications and tuned during the warranty period to provide stable control.

H. Minimum Points List (each): (T = Trend, A = Alarm, G = Show on Graphics)

1. Analog Inputs:

Zone Setpoint Adjust	(1)	(G)
Zone Temperature	(1)	(T/G)
Discharge Air Flow	(1)	(T/G)
Discharge Air Temp	(1)	(T/G)

2. Analog Outputs:

Zone Damper	(1)	(T/G)
Reheat Valve	(1)	(T/G)

3. Binary Inputs:

Zone Override	(1)	(T/G)

4. Analog Data:

Zone Airflow Setpoint	(1)	(T/G)
Zone Heating Setpoint	(1)	(T/G)
Zone Cooling Setpoint	(1)	(T/G)
Min Occupied Airflow Setpoint	(1)	(G)
Max Cooling Airflow Setpoint	(1)	(G)
Max Heating Airflow Setpoint	(1)	(G)

END OF SECTION

SECTION 25 9598 - MISC SEQUENCES

1.1 OUTSIDE AIR CONDITIONS

A. Outside Air Monitoring:

1. A controller shall monitor outside air temperature and humidity on a continual basis. This value shall be made available to the system at all times.

    a. If a temperature sensor cannot be read, a default value of 0ºF will be used.

    b. If a humidity sensor cannot be read, a default value of 50%RH will be used.

2. Alarms shall be generated as follows:

    a. Sensor Failure: Sensor reading indicates shorted or disconnected sensor.

B. Cold Weather Setback Override: Below an outside air temperature of 25°F (adj), the system shall globally modify all unoccupied zone temperature setpoints to 70°F (adj). Provide adjustable software setpoints on the outside air conditions graphic.

1.2 MONITORING AND ALARMS

A. Monitor space temperature in various locations indicated on the drawings. Install blank or plate-type zone sensors and provide thermographic floor plan display, data trending, and alarm output.

1. In data rooms, electrical rooms, and similar locations, provide an alarm output if space temperature is greater than 80ºF (adj) for longer than 30-min.

2. In entryways, stairwells, and similar locations, provide an alarm output if space temperature is less than 50ºF (adj) for longer than 30-min.

B. Monitor space relative humidity in various locations indicated on the drawings. Install humidity sensors and provide graphic display, data trending, and alarm notification.

1. In data rooms provide an alarm output if space relative humidity is less than 20-percent (adj) for longer than 30-min.

2. In crawl space locations provide an alarm output if space relative humidity is greater than 50-percent (adj) for longer than 120-min.

C. Monitor domestic hot water supply/tank temperature and domestic hot water return temperature. Provide graphic display, data trending, and alarm outputs if supply temperature is less than 100ºF or greater than 130ºF (both adj) for longer than 30-min.

D. The domestic hot water recirculation pump shall run according to an operator definable schedule, or whenever area equipment is indexed to an occupied condition. Provide graphic display, status monitoring, data trending, and alarm notification of pump failure.

1.3 SCHEDULED EXHAUST

A. Where indicated, exhaust fans shall run according to an operator definable schedule, or when an area zone or zone group is indexed to an occupied override condition. Provide graphic display, status monitoring, data trending, and alarm notification.

B. Alarms shall be provided as follows:

1. Fan Failure: Commanded on, but the status is off.

2. Fan in Hand: Commanded off, but the status is on.

1.4 CONTINUOUS EXHAUST

A. Where indicated, exhaust fans are wired for continuous operation by the electrical contractor. Provide graphic display, status monitoring, data trending, and alarm notification.

B. Alarms shall be provided as follows:

1. Fan Failure: Commanded on, but the status is off.

1.5 SWITCHED EXHAUST

A. Where indicated, exhaust fans are wired for switched control by the electrical contractor. No fan status is required.

1.6 COMPUTER ROOM AIR CONDITIONING

A. The computer room air conditioner is supplied with integrated operating and safety controls, and a BACnet interface (confirm via submittals). Wire the interface and provide graphic display, status monitoring, data trending, and alarm notification.

B. The following data shall be monitored and trended by the BAS thru the units integrated interface. Read-only and read-write data shall be mapped into the BAS as follows:

1. Space temperature and relative humidity setpoint (RW).

2. Unit state, return air temp, and relative humidity (RO).

END OF SECTION

DIVISION

26

ELECTRICAL

SECTION 26 0010 - GENERAL ELECTRICAL REQUIREMENTS

PART I - GENERAL

1.1 RELATED DOCUMENTS AND REQUIREMENTS

A. Specifications throughout all divisions of the project manual are directly applicable to this section, and this section is directly applicable to them.

B. Drawings, specification sections and other documents which form the basis for the Contract apply to all work of Division 26, Division 27, and Division 28.

1.2 SUMMARY

A. This section includes general requirements for electrical work and is supplemental and in addition to the requirements of Division 01. This section applies to work of all Division 26, Division 27, and Division 28 sections.

B. Provide all materials, appliances, apparatus, safety precautions, programs and methods, whether specifically mentioned or not, which are necessary for a complete electrical installation.

1.3 REGULATORY REQUIREMENTS

A. Errors and omissions in the Contract Documents do not relieve the contractor from providing the work in accordance with regulatory requirements.

B. As a minimum, execute, test and inspect work in accordance with Underwriters and State and Local codes, rules, and regulations applicable to the trade involved. If plans or specifications call for requirements in excess of these codes, rules and regulations, the greater requirement shall apply. Included are the requirements of IBC, NFPA, NEC, OSHA, NEMA, ICEA, ANSI, ASTM, UL, EIATIA, UBC, and Federal Specifications.

C. Obtain and pay for all permits, licenses, and inspections required by laws, ordinances and rules that govern the work of this project.

D. Where a conflict between Division 26, Division 27, and Division 28 drawings and specifications arise, The specifications shall take precedence.

E. All materials furnished and all work installed shall comply with locally adopted, international, or uniform building and fire protection codes, with the requirements of local utility companies, and with the requirements of all governmental authorities having jurisdiction.

1.4 DRAWINGS

A. The drawings are to scale as noted; however refer to the architectural plans for exact building dimensions and civil plans for exact site dimensions. Do not scale electrical drawings.

B. Drawings are diagrammatic. No attempt has been made to show every conduit, fitting, device, connection or detail of construction.

C. Consult other drawings of the project for correlating information. Pay particular attention to door swings, casework, fixed furniture, piping, radiation and structural steel. No additional compensation will be allowed for the moving of misplaced items.

D. Since drawings are at a small scale, outlets, devices, equipment, etc., are indicated only in their approximate locations. Verify final locations for rough-ins with field measurements and with the requirements of the equipment to be installed. In the event of conflicts with other systems or building components, notify the Architect whose decision will govern. Make changes required to correct conflicts at no change in contract cost to the Owner.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

1.5 PROJECT COORDINATION

A. Project Coordinator: General Contractor (GC)

B. Make the following types of submittals to Architect through the Project Coordinator:

1. Preconstruction Submittals
    a. Requests for Substitution.
    b. Proposed Product Lists.
    c. Shop drawings, product data, and samples.
    d. Coordination Drawings.
    e. Manufacturer's Instructions.
2. Construction Submittals
    a. Requests for Interpretation.
    b. Proposal Requests
    c. Credit/Deduct Change Orders
3. Substantial Completion Submittals
    a. Source Quality Control Test Reports
    b. Field Quality Control Test and Inspection Reports.
    c. Schedule of Owner Training.
4. Closeout Submittals
    a. Corrected Test and Inspection Reports.
    b. Certification of Owner Training.
    c. Maintenance Materials.
    d. Operation & Maintenance Manuals.
    e. Inspector Certificates of Acceptance
    f. Warranty Certificates

C. Coordinate work with other Contractors and trades doing work on the project. Examine drawings and specifications of other trades for construction details. Make every effort to prevent conflicts or interferences with other trades.

D. Before ordering equipment, determine that equipment will pass through building openings and passageways that provide unobstructed access to final equipment locations. Determine that equipment will properly fit in the designated space without conflict with other systems, and that Code required spaces and access can be maintained.

E. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

F. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

G. Comply with working clearances identified in Article 110-26 2023 NEC and coordinate with Division 22 and Division 23 subcontractor to insure that no piping, ductwork or equipment is installed in the exclusively dedicated space for switchboards or panelboards within the scope of the NEC.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.6 JOB CONDITIONS

A. Examine the project site prior to bidding and become familiar with all existing conditions that may affect the bid, No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

B. Inspect materials upon arrival at the site and verify conformance with Contract Documents. Containers that are broken, opened, damaged or water marked are unacceptable. All material, except items specifically designed to be installed outdoors, shall be stored in an enclosed dry building or trailer.

C. Protect work, materials and equipment from theft and damage. Be responsible for any such theft or damage until project acceptance by the Owner.

PART 2 - PRODUCT REQUIREMENTS

2.1 STANDARDS

A. Unless otherwise indicated, provide only first-quality new materials and equipment, free from defects, in first class condition, suitable for the application and for installation in the space provided. Unless specifically required or permitted by the Contract Documents.

B. Unless otherwise indicated, material and equipment shall be the standard current products of manufacturers regularly engaged in the manufacture of such products.

C. Provide material and equipment listed by UL or other approved testing organization wherever standards have been established for that product unless otherwise permitted by the Authority

Having Jurisdiction. Custom designed products shall be constructed from UL approved materials and approved by UL as a complete assembly.

D. Where two or more products of the same class are required, provide products of a single manufacturer.

2.2 SUBSTITUTIONS

A. Products are specified by naming one or more manufacturers with a provision for substitutions. Submit any requests for substitution of specified materials not named prior to bidding in accordance with the provisions of Division 01.

B. Provide sufficient material or data to allow evaluation of proposed alternatives and determination of compliance with the Contract Documents. Specifically List any deviations from the Contract Documents.

C. Where such alternatives alter the design or space requirements, include in the proposal, all items of cost for revised design and construction, including the cost of all allied trades involved.

D. Where specific products are mentioned by name or part number, the proposed substitute must meet all the standard services and functionality of the specified system weather explicitly mentioned or not.

E. Division 01 instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

F. All product substitutions shall be by addendum, or with written approval only.

G. Substitutions after the bid will be considered when a product becomes unavailable through no fault of the EC.

H. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

I. A request for substitution constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
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.

J. Substitution Submittal Procedure:

1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.

2.3 SUBMITTALS

A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

1. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

2. Shop Drawing Submittals: Prepared specifically for this Project.

3. Submit shop drawings and product data as required by various sections of Division 26, Division 28 in accordance with Division 01 . Make submittals to the Architect.

a. Do not submit directly to the Engineer

4. Do not use materials and equipment removed from the existing premises, except as specifically permitted by the Contract Documents.

B. Provide submittals for equipment as described in the electrical drawings as well as each section of these electrical specifications, including, but not limited to all sections of Division 26, Division 27, and Division 28.

C. Submittals will be reviewed by the Engineer only for general compliance with the intent of the Contract Documents. Review does not extend to details of construction, dimensions or equipment quantities.

D. Review of submittals and action recommended as a result of review is a courtesy extended to the Contractor by the Engineer. Errors in submittals are the sole liability of the Contractor. Submission of material for review does not alter the Contractors responsibility to comply with the Contract Documents regardless of action noted in the Engineer's review.

E. Submittals shall include all information necessary to properly identify and evaluate all components of the equipment being submitted for review. Any proposed equipment variances from the Contract Documents must be clearly highlighted. If this is not done the Engineer reserves the right to reject such equipment at any time before or after installation.

F. Submittals shall be bound in folders with covers that indicate the project name and equipment included within the folder. The Contractor's review stamp, dated and initialed, shall be on the folder cover or cover page. Provide tab dividers, properly identified, to identify different categories of equipment. If more than one item of equipment is shown on the same catalog page, that equipment which is applicable to the project must be clearly identified.

1. Contractor's stamp implies that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

G. Incomplete or improperly formatted submittals will not be reviewed.

H. When revised for resubmission, identify all changes made since previous submittal.

2.4 EQUIPMENT HOUSEKEEPING PADS

A. Fixed concrete bases for electrical equipment, including transformer pad requirements, will be provided under Division 03.

B. Coordinate with Division 03 Contractor to assure that all outside corners are beveled, anchor bolts are provided per equipment manufacturer's recommendations, and that pad horizontal dimensions are 3" larger than the footprint of the equipment on front and sides.

C. Equipment housekeeping pads for electrical equipment are to be provided by the Electrical Contractor.

   1. Insure that all outside corners are beveled, anchor bolts are provided per equipment manufacturer's recommendations, and that pad horizontal dimensions are 3" larger than the footprint of the equipment on front and sides.

D. Pad depth shall be minimum four inches.

E. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to the pads.

F. Product Substitution: For any proposed change in materials, submit request for substitution as described in the Contract Documents.

PART 3 - ADMINISTRATIVE REQUIREMENTS

3.1 NOT USED - REFER TO 01 FOR REQUIREMENTS

PART 4 - EXECUTION REQUIREMENTS

4.1 GENERAL

A. Workmanship shall be first quality and none but competent electricians, licensed in the State of Wyoming, shall be employed. All work shall be performed under supervision of an experienced, and competent foreman, licensed in the State of Wyoming, and in complete compliance with all applicable codes.

B. The finished appearance of electrical work shall be first class. Install systems, materials and equipment level and plumb, and parallel and perpendicular to building components where installed exposed. Install electrical equipment to facilitate servicing, maintenance and repair or replacement of equipment components.

C. Follow manufacturer's installation instructions explicitly unless otherwise indicated. Whenever any conflict arises between the manufacturer's instructions and the Contract Documents notify the Architect and comply with Architect's decision. Keep copy of manufacturer's installation instructions on job site available for review at all times.

D. Do no work without proper documents or written instruction. Any work completed without proper authorization will not be considered for additional compensation.

E. Contractor shall replace any improperly executed work at his cost.

F. Install electrical equipment to facilitate servicing maintenance and repair of replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

G. In finished areas ,except as otherwise indicated; conduit and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

H. No back to back electrical boxes inside walls, maintain a 6” inch minimum spacing between boxes and no more than 2 boxes in any joist space.

I. All ceiling mounted devices (i.e. smoke detectors, light fixtures, etc.) shall be installed centered in ceiling tiles. Coordinate with ceiling installer.

J. Electrical devices are shown on Drawings in approximate locations unless dimensioned. Adjust devices up to five feet if required to accommodate intended purpose.

K. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

L. Examine and verify specific conditions described in individual specification sections.

M. Verify that utility services are available, of the correct characteristics, and in the correct locations.

4.2 TRANSPORTATION, STORAGE, AND PROTECTION

A. Transport and handle products in accordance with manufacturer's instruction. All transportation costs for Division 26 and Division 28 equipment shall be by this contractor.

B. Store and protect products in accordance with manufacturer's instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather-tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide off-site storage and protection when site does not permit on-site storage or protection. Certificate of insurance is required for off-site storage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

H. Protect installed work and provide special protection where specified in individual specification sections.

4.3 TEMPORARY LIGHTING AND POWER

A. Temporary Power

1. Provide a minimum 240/120V, 200A, single phase, three wire, service with main disconnect, and over current protection at a convenient location.

2. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

    a. Provide 20A duplex receptacles for power tools every 2,500 square feet of active work area. All duplex receptacles used for construction purposes shall be provided with ground fault protection for personnel.

    b. Provide 20A single phase branch circuits for lighting.

B. Temporary Lighting

1. Provide and maintain incandescent lighting for construction operations per OSHA 1926.56.
2. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
3. Maintain lighting and provide routine repairs. Replace lamps as required during construction phase. Task lighting for painting and finishing shall be provide by the associated contractor.
4. Upon completion of the work, remove all temporary facilities from the project site.

C. Promptly notify the architect of any discrepancies discovered.

4.4 CUTTING AND PATCHING

A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Conform to Architect's direction for location and method of cutting. Cut carefully, and only the minimum amount necessary.

B. Submit written request in advance of cutting or alteration which affects:

1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.
6. Include in request:
    a. Location and description of affected work.
    b. Necessity for cutting or alteration.
    c. Description of proposed work and products to be used.

C. Repair any damage equal to the original condition, at minimum. Use materials and methods acceptable to the Architect.

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

E. Fit work air tight to conduit and other penetrations through surfaces.

F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with latest approved materials and methods, to full thickness of the penetrated element.

4.5 PAINTING AND CLEANING

A. Touch up panelboards and other items of electrical equipment not “finish painted” under other sections if finished surface is marred or damaged. Use paint furnished by the equipment manufacturer specifically for that purpose.

B. Leave all equipment, lighting fixtures, etc., in clean condition, with all unnecessary labels removed. Use cleaning materials appropriate to the surface and material being cleaned.

C. Clean up and remove all electrical construction debris from the site both prior to final project assessment and after completion of the work.

4.6 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems with Architect, Engineer, And Project Coordinator.

B. Notify General Contractor and Owner seven days prior to start-up of each item.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. When specified in individual Specification Sections, Contractor to require that equipment manufacturer provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

H. Adjust operating products and equipment to ensure smooth and unhindered operation. Refer to individual sections for additional adjustment requirements.

PART 5 - CLOSE OUT REQUIREMENTS

5.1 CLOSEOUT PROCEDURES

A. Notify General Contractor when work is considered ready for Substantial Completion.

B. Provide Substantial Completion Submittals as required by Division 01 and these specifications.

C. Provide close out submittals as required by Division 01 and these specifications.

D. Notify GC when work is considered finally complete.

E. Complete items of work determined by Engineer's final inspection.

F. Turn over complete, legible, set of “red-line” line documents accurately reflecting as-constructed changes to design layouts.

5.2 TESTING AND DEMONSTRATIONS

A. Test and demonstrate that all electrical equipment and systems operate in accordance with the requirements of the Contract Documents and manufacturer's instructions. Repair or replace any equipment or system that fails the tests and demonstrations.

B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

5.3 OPERATING AND MAINTENANCE MANUALS

A. Submit Operating and Maintenance Manuals for the following equipment. Include, as a minimum, all information incorporated in the submittals.

1. Lighting Fixtures
2. Lighting Poles
3. Panelboards and Switchboards
4. Generator and transfer switch.
5. Fire Alarm Panel, Devices, and Riser Diagram.
6. Lighting Control Equipment (Timeclock, Photocell, Relays, Switches, and Enclosure)
7. Service Equipment. Including but not limited to CT Cabinet, Meter Base, Surge Protective Device, Service Disconnect, and Transformer Pad-Vault.
8. Fuses and Connector Kits
9. Wiring Devices
10. Safety Switches and Disconnects
11. Structured Data Racks, Cabling, and Outlets
12. Fiber Optic Cables and Equipment

B. Make up required operating and maintenance manuals no later than two weeks prior to completion of the project.

C. Include warranties, description of required testing and testing methods and details of routine maintenance.

D. Include recommended replacement parts with names, addresses, and telephone numbers of service organizations that carry the parts in stock.

E. Manuals shall be 8.5x11, bound in hard back binder, suitably labeled for identification. Accordion fold larger sheets to this size. Provide index page and plastic tabs coordinated with the index.

F. Submit one copy of the manual to the Engineer for review, and after review make noted changes. Turn over 3 copies of the final manual to the Owner.

G. The Contract is not complete and final payment to the contractor will not be made until final operating and maintenance manuals are received and accepted.

5.4 SUBMITTALS FOR PROJECT CLOSEOUT

A. Project Record Documents: Submit the following items/documents to Architect for project closeout submittals.

1. Record Drawings and Specifications (One (1) clean set with Change Orders identified).
2. A one-year warranty statement on company stationary.
3. Submit material and labor warranty as specified.
4. Operating and maintenance manuals.

END OF SECTION

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Armored cable.

C. Metal-clad cable.

D. Wiring connectors.

E. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

F. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

G. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

H. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.

I. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers.

J. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation.

K. NECA 1 - Standard for Good Workmanship in Electrical Construction.

L. NECA 104 - Standard for Installing Aluminum Building Wire and Cable.

M. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable.

N. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

O. NFPA 70 - National Electrical Code.

P. UL 4 - Armored Cable.

Q. UL 44 - Thermoset-Insulated Wires and Cables.

R. UL 83 - Thermoplastic-Insulated Wires and Cables.

S. UL 486A-486B - Wire Connectors.

T. UL 486C - Splicing Wire Connectors.

U. UL 486D - Sealed Wire Connector Systems.

V. UL 1569 - Metal-Clad Cables.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
    a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
        1) Maximum Length: 6 feet.

G. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
    a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
        1) Maximum Length: 6 feet.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:

1) Services: Copper conductors size 1/0 AWG and larger.

2) Feeders: Copper conductors size 1/0 AWG and larger.

b. Where aluminum conductors are substituted for copper, comply with the following:

1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.

2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.

3) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

3. Tinned Copper Conductors: Comply with ASTM B33.

4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

1) Conductors must be sized appropriately for voltage drop per NFPA 70.

2. Control Circuits: 14 AWG.

I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

2. Color Coding Method: Integrally colored insulation.

a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.

3. Color Code:

a. 480Y/277 V, 3 Phase, 4 Wire System:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

4) Neutral/Grounded: Gray.

b. 208Y/120 V, 3 Phase, 4 Wire System:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.

d. Isolated Ground, All Systems: Green with yellow stripe.

e. Travelers for 3-Way and 4-Way Switching: Pink.

f. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Solid.

b. Size 8 AWG and Larger: Stranded.

2. Control Circuits: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.4 ARMORED CABLE

A. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN.

E. Grounding: Combination of interlocking armor and integral bare bonding wire.

F. Armor: Steel, interlocked tape.

2.5 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

E. Grounding: Full-size integral equipment grounding conductor.

F. Armor: Steel, interlocked tape.

2.6 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
3. Connectors for Aluminum Conductors: Use compression connectors.

C. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
3. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
4. Aluminum Conductors: Use compression connectors for all connections.

5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
6. Conductors for Control Circuits: Use crimped terminals for all connections.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
6. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

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

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install armored cable (Type AC) in accordance with NECA 120.

F. Install metal-clad cable (Type MC) in accordance with NECA 120.

G. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

H. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

I. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

J. Terminate cables using suitable fittings.

1. Armored Cable (Type AC):

a. Use listed fittings and anti-short, insulating bushings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

2. Metal-Clad Cable (Type MC):

a. Use listed fittings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

K. Install conductors with a minimum of 12 inches of slack at each outlet.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
    a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
    b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
    a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
    b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use heat shrink tubing.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.2 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NFPA 70 - National Electrical Code.

E. UL 467 - Grounding and Bonding Equipment.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

a. Provide continuous grounding electrode conductors without splice or joint.

b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):

a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.

b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Concrete-Encased Electrode:

a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

4. Ground Rod Electrode(s):

a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.

b. Space electrodes not less than 10 feet from each other and any other ground electrode.

c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.

5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

F. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.

2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:

a. Transformers (except autotransformers such as buck-boost transformers).

2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

H. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

I. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
    a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
    c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.

a. Exceptions:

1) Use bare copper conductors where installed underground in direct contact with earth.

2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.

3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install

at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

F. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

G. Install ground rod electrodes as required to achieve specified resistance to ground.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.3 FIELD QUALITY CONTROL

A. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

B. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Division 03.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
    a. NFPA 70.
    b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
    a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: 1/2-inch diameter.
    b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
    c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.

d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.

e. Outlet Boxes: 1/4-inch diameter.

f. Luminaires: 1/4-inch diameter.

F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.

2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

2. Concrete: Use expansion anchors or screw anchors.

3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

4. Hollow Masonry: Use toggle bolts.

5. Hollow Stud Walls: Use toggle bolts.

6. Steel: Use beam clamps, machine bolts, or welded threaded studs.

7. Sheet Metal: Use sheet metal screws.

8. Wood: Use wood screws.

9. Plastic and lead anchors are not permitted.

10. Powder-actuated fasteners are not permitted.

11. Hammer-driven anchors and fasteners are not permitted.

12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

a. Manufacturer: Same as manufacturer of metal channel/strut framing system.

b. Comply with MFMA-4.

c. Channel Material: Use galvanized steel.

13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.

2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 4 inches in height; see Division 03.

I. Conduit Support and Attachment: See Section 26 0533 for additional requirements.

J. Box Support and Attachment: See Section 26 0534 for additional requirements.

K. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.

L. Exterior Luminaire Support and Attachment: See Section 26 5600 for additional requirements.

M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

N. Secure fasteners in accordance with manufacturer's recommended torque settings.

O. Remove temporary supports.

END OF SECTION

SECTION 26 0533 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. PVC-coated galvanized steel rigid metal conduit (RMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Galvanized steel electrical metallic tubing (EMT).

F. Aluminum electrical metallic tubing (EMT).

G. Rigid polyvinyl chloride (PVC) conduit.

1.2 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

J. NFPA 70 - National Electrical Code.

K. UL 1 - Flexible Metal Conduit.

L. UL 6 - Electrical Rigid Metal Conduit-Steel.

M. UL 360 - Liquid-Tight Flexible Metal Conduit.

N. UL 514A - Metallic Outlet Boxes.

O. UL 514B - Conduit, Tubing, and Cable Fittings.

P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

Q. UL 797 - Electrical Metallic Tubing-Steel.

R. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit, PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) or PVC-coated galvanized steel rigid metal conduit (RMC) where emerging from underground.
4. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows or PVC-coated galvanized steel rigid metal conduit (RMC) elbows for bends.

D. Embedded Within Concrete:

1. Within Slab on Grade: Not permitted.
2. Within Slab Above Ground: Not permitted.

E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.

I. Exposed, Exterior: Use galvanized steel rigid metal conduit.

J. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

K. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).

   1. Maximum Length: 6 feet.

L. Flexible Connections to Vibrating Equipment:

   1. Dry Locations: Use flexible metal conduit (FMC).
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.
      c. Air Handling Equipment.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Electrical Service Conduits: See Section 26 2100 for additional requirements.

C. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:

   1. Branch Circuits: 3/4-inch trade size.
   2. Branch Circuit Homeruns: 3/4-inch trade size.
   3. Control Circuits: 1/2-inch trade size.
   4. Flexible Connections to Luminaires: 3/8-inch trade size.
   5. Underground, Interior: 3/4-inch trade size.
   6. Underground, Exterior: 1-inch trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

C. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.

2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.

3. Material: Use steel or malleable iron.

4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction with PVC jacket.

2.7 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel.

3. Connectors and Couplings: Use set-screw type.

a. Do not use indenter type connectors and couplings.

4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.8 ALUMINUM ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT aluminum electrical metallic tubing listed and labeled as complying with UL 797A.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; listed for use with aluminum EMT.

2. Material: Use aluminum.

3. Connectors and Couplings: Use set-screw type.

a. Do not use indenter type connectors and couplings.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

D. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

E. Sealing Systems for Concrete Penetrations:

1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.

E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

F. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
    a. Electrical rooms.
    b. Mechanical equipment rooms.
    c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
    a. Across floors.
    b. Across roofs.
    c. Across top of parapet walls.
    d. Across building exterior surfaces.
6. Conduits installed underground may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in same area on common rack.

G. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.

H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Conceal bends for conduit risers emerging above ground.
4. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

5. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
6. Provide metal escutcheon plates for conduit penetrations exposed to public view.
7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.

J. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
a. Underground, Exterior: 18 inches.
b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 0553.

K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
a. Where conduits enter building from outside.
b. Where service conduits enter building from underground distribution system.
c. Where conduits enter building from underground.
d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
a. Where conduits pass from outdoors into conditioned interior spaces.
b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

N. Provide grounding and bonding; see Section 26 0526.

O. Identify conduits; see Section 26 0553.

3.3 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. 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 20 minutes, minimum.

C. Use conduit hubs to fasten conduit to cast boxes.

D. Install conduit to preserve fire resistance rating of partitions and other elements.

END OF SECTION

SECTION 26 0534 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Underground boxes/enclosures.

C. Floor boxes.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2726 - Wiring Devices:

1. Wall plates.
2. Floor box service fittings.
3. Poke-through assemblies.
4. Additional requirements for locating boxes for wiring devices.

G. Section 27 1000 - Structured Cabling and Equipment for Voice and Data: Additional requirements for communications systems outlet boxes.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

E. NFPA 70 - National Electrical Code.

F. SCTE 77 - Specifications for Underground Enclosure Integrity.

G. UL 514A - Metallic Outlet Boxes.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for floor boxes.

B. Project Record Documents: Record actual locations for underground handhole enclosures.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use cast iron boxes where exposed galvanized steel rigid metal conduit is used.
4. Use suitable concrete type boxes where flush-mounted in concrete.
5. Do not use "through-wall" boxes designed for access from both sides of wall.
6. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
7. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
8. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
9. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
10. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
11. Wall Plates: Comply with Section 26 2726.

C. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use sheet-steel or cast iron floor boxes within slab above grade.
3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
4. Manufacturer: Same as manufacturer of floor box service fittings.

D. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As Required..

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
    a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
    b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
    c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
    a. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Box Locations:
    1. Locate boxes to be accessible. Provide access panels as requiredwhere approved by the Architect..
    2. Unless dimensioned, box locations indicated are approximate.
    3. Locate boxes as required for devices installed under other sections or by others.
        a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
        b. Communications Systems Outlets: Comply with Section 27 1000.

4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

G. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use of wire for support of boxes is not permitted.
5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

H. Install boxes plumb and level.

I. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

J. Install boxes as required to preserve insulation integrity.

K. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

L. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches deep.

2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

O. Close unused box openings.

P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

Q. Provide grounding and bonding in accordance with Section 26 0526.

R. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION

SECTION 26 0536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal cable tray systems:

1. Metal ladder cable tray.
2. Metal wire mesh/basket cable tray.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts. Coordinate work to avoid installation of obstructions within cable tray required clearances.
2. Coordinate arrangement of cable tray with dimensions and clearance requirements of actual products to be installed.
3. Coordinate work with placement of supports and anchors required for mounting.
4. Notify of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of affected installers. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.

C. Sequencing:

1. Do not begin installation of cables until installation of associated cable tray run is complete.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.

B. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA BI-50016, except do not store cable tray outdoors without cover as permitted in NEMA BI-50016.

B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.1 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

A. Provide new cable tray system consisting of required components, fittings, supports, and accessories, as necessary for complete system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.

D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under service conditions at installed location.

E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (i.e., no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA BI 50015.

F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA BI 50015 including applicable allowable tolerances.

2.2 METAL CABLE TRAY SYSTEMS

A. Manufacturers:

1. ABB, Inc: www.new.abb.com/#sle.
2. Cablofil, a brand of Legrand North America, Inc: www.legrand.us/cablofil/#sle.
3. Source Limitations: Furnish cable tray system and associated components and accessories produced by single manufacturer and obtained from single supplier.

B. Comply with NEMA BI 50015.

C. Material/Finishes:

1. Zinc Electroplated Steel: Comply with ASTM B633.
2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
3. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel: Comply with ASTM A123/A123M.

D. Metal Ladder Cable Tray:

1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
2. Side Rail Construction: I-beam.

3. Load/Fill Depth: 4 inches.
4. Span/Load Rating: NEMA VE 1 Class 12C.
5. Rung Spacing: 9 inches on center for straight lengths.
6. Inside Width: 24 inches.
7. Inside Radius of Fittings: 12 inches.

E. Metal Wire Mesh/Basket Cable Tray:

1. Material: Zinc-electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
2. Tray Depth: 6 inches.
3. Mesh Spacing: 2 by 4 inches.
4. Tray Width: 12 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install cable tray in accordance with NECA 1 (general workmanship) and NEMA BI-50016.

C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.

D. Arrange cable tray to provide required clearances and maintain cable access.

E. Install cable tray plumb and level, with sections aligned and with horizontal runs at specified elevation.

F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.

1. Inside Radius of Fittings: 12 inches.

G. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel Cable Tray: After cutting, drilling, or deburring, use approved zinc-rich paint to repair finish in accordance with ASTM A780/A780M.

H. Cable Tray Movement Provisions:

1. Provide expansion fittings where cable tray is subject to movement, including but not limited to:
    a. Where cable tray crosses structural joints intended for expansion.
    b. Long straight cable tray runs in accordance with NEMA BI-50016.
2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA BI-50016.
3. Set gaps for expansion fittings in accordance with NEMA BI-50016.

I. Cable and Conductors:

1. Ampacity: As determined by applications listed in NFPA 70.

J. Cable Provisions:

1. Use fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
2. Use drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
3. Use cable support fittings for long vertical cable tray runs with heavy cables.

K. Provide end closures at unconnected ends of cable tray runs.

L. Cable Tray Support:

1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA BI-50016 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment where not furnished by cable tray manufacturer.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

M. Grounding and Bonding Requirements:

1. Comply with grounding and bonding requirements of NEMA BI-50016.
2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified cable tray connectors to provide electrical continuity. Do not use classified cable tray connectors where cable tray sections have been modified, such as being bent, cut, or reshaped.
3. Provide suitable equipment grounding conductor in each metal cable tray, except where cable tray contains only multiconductor cables with integral equipment grounding conductors. Do not use metal cable tray system as sole equipment grounding conductor.
    a. Equipment Grounding Conductor for Galvanized Steel Cable Tray: Use bare or insulated copper conductor.
    b. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
    c. Bond equipment grounding conductor to each metal cable tray section using suitable listed ground clamps. Separate bonding jumpers are not required where properly bonded equipment grounding conductor provides equivalent continuity.

N. Conduit Termination:

1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.
2. Provide insulating bushing at conduit termination to protect cables.
3. Provide independent support for conduit.

O. Cable Installation:

1. Install cables in accordance with cable installation requirements of NEMA BI-50016.
2. Use appropriate cable pulling tools, applied to prevent excessive force on cable tray system and maintain minimum cable bending radius.
3. Use cable clamps or cable ties to fasten conductors/cables to vertical and horizontal runs of cable tray

a. Distance Between Fastening Points for Vertical Runs: 18 inches.

b. Distance Between Fastening Points for Horizontal Runs: As required to maintain spacing and confine conductor/cable within cable fill area.

P. Penetrations: Install firestopping to preserve fire resistance rating of building elements.

Q. Identification Requirements:

3.2 FIELD QUALITY CONTROL

A. Inspect cable tray system for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective cable tray system components.

3.3 ADJUSTING

A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.4 CLEANING

A. Remove dirt and debris from cable tray.

B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Warning signs and labels.

G. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

H. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

I. Section 27 1000 - Structured Cabling and Equipment for Voice and Data: Identification for communications cabling and devices.

1.2 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code.

B. NFPA 70E - Standard for Electrical Safety in the Workplace.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Panelboards:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location when not within sight of equipment.

4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Transformers:

1) Identify kVA rating.

2) Identify voltage and phase for primary and secondary.

c. Enclosed switches, circuit breakers, and motor controllers:

1) Identify voltage and phase.

2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

d. Time Switches:

1) Identify load(s) served and associated circuits controlled. Include location.

e. Enclosed Contactors:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify load(s) and associated circuits controlled. Include location.

f. Transfer Switches:

1) Identify voltage and phase.

2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.

3) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

3. Emergency System Equipment:

a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

4. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.

5. Use identification label on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.

6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    a. Service equipment.
    b. Panelboards and Switchboards.
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
    a. Minimum Size: 3.5 by 5 inches.
    b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
    c. Service Equipment: Include the following information in accordance with NFPA 70.
        1) Nominal system voltage.
        2) Available fault current.
        3) Clearing time of service overcurrent protective device(s).
        4) Date label applied.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Raceways:
1. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
2. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    a. For exposed boxes in public areas, provide identification on inside face of cover.

E. Identification for Devices:

1. Identification for Communications Devices: Comply with Section 27 1000.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    a. For receptacles in public areas, provide identification on inside surface of wallplate.
4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
5. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
    1. Materials:
        a. Indoor Clean, Dry Locations: Use plastic nameplates.
    2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
        a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
    3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
    1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
    2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
    1. Minimum Size: 1 inch by 2.5 inches.
    2. Legend:
        a. Equipment designation or other approved description.
    3. Text: All capitalized unless otherwise indicated.
    4. Minimum Text Height:
        a. Equipment Designation: 1/2 inch.
    5. Color:
        a. Normal Power System: White text on black background.
        b. Emergency Power System: White text on red background.

D. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

2.3 VOLTAGE MARKERS

A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

B. Minimum Size:
   1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   2. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

C. Legend:
   1. Markers for Voltage Identification: Highest voltage present.

D. Color: Black text on orange background unless otherwise indicated.

2.4 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Elevated Equipment: Legible from the floor or working platform.
4. Branch Devices: Adjacent to device.
5. Interior Components: Legible from the point of access.
6. Conduits: Legible from the floor.
7. Boxes: Outside face of cover.
8. Devices: Outside face of cover.

C. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

D. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

E. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 26 0583 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 REFERENCE STANDARDS

A. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

B. NFPA 70 - National Electrical Code.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
2. Determine connection locations and requirements.

B. Sequencing:

1. Install rough-in of electrical connections before installation of equipment is required.
2. Make electrical connections before required start-up of equipment.

1.4 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Conform to NEMA WD 1.
2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2818.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0533.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0534.

G. Motor Controllers: As specified in Section 26 2913.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 EQUIPMENT CONNECTIONS

A. Furnish and install all wiring except temperature control wiring, equipment control wiring which does not conduct full load motor current, and interlock wiring, unless indicated otherwise. Furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring through starters.

B. Unless otherwise indicated, all hvac and plumbing equipment motors and controls shall be furnished, set in place, and wired in accordance with the following schedules:

	Furnished By	Installed By	Power Wired By	Control Wired By
Equipment motors	MC	MC	EC	-
Magnetic motor starters, manual or auto control w/ or w/o hand-off-auto	EC	EC	EC	MC
Magnetic motor starters supplied as part of factory wired equipment	MC	MC	EC	MC
Combination magnetic motor starter disconnects	EC	EC	EC	MC
Disconnect switches and thermal overload switches	EC	EC	EC	-
Pushbuttons and pilot lights:				
a. Full load motor amps	MC	EC	EC	EC
b. Non-full load motor amps	MC	MC	-	MC
Manual/multi-speed switches	MC	EC	EC	EC
Temperature control relays and transformers	MC	MC	EC	MC
Thermostats:				
a. Full load motor amps	MC	EC	EC	EC
b. Non-full load motor amps	MC	MC	-	MC
Temperature control panels and time clocks mounted within panels	MC	MC	EC	MC
Motorized valves, damper motors and remote bulb thermostats	MC	MC	EC	MC

Solenoid valves, PE switches, EP switches, etc.	MC	MC	EC	MC
Smoke detectors and relays for fan shutdown:				
a. Bldg w/ fire alarm system	EC	EC	EC	EC
b. Bldg w/o fire alarm system	MC	MC	MC	MC
Boiler and/or burner controls	MC	MC	EC	MC

C. EC to install all starters and disconnects not factory mounted on equipment. The Mechanical Contractor shall provide and be responsible for the overload "heaters" in all starters furnished under Divisions 22 and 23.

D. Control relay and control transformers shall be furnished under the mechanical contract except where furnishing such items is specifically required under the electrical specifications and/or drawings.

E. EC shall provide power to all temperature control panels. Location and quantity of control panels shall be determined by control contractor.

F. Provide field-installed disconnect switch when not in direct sight of Panelboard, Loadcenter, or Motor Controller.

3.3 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Provide hardwired electrical connections using flexible conduit.

K. For Cord and Plug electrical connections, provide receptacle with proper configuration to match equipment plug.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

B. Time switches.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

E. NFPA 70 - National Electrical Code.

F. UL 916 - Energy Management Equipment.

G. UL 917 - Clock-Operated Switches.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
2. Coordinate placement of wall switch occupancy sensors with installed door swings.
3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
4. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 5100 and lighting fixture schedule.
5. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
2. Time Clocks

B. Operation and Maintenance Data: Include detailed information on device programming and setup.

C. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 WARRANTY

A. Provide five year manufacturer warranty for occupancy sensors.

B. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for purpose intended.

B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Legrand North America, Inc: www.legrand.us/#sle.
3. Or Approved equal.

B. General Requirements:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.

c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.

3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.

4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.

6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.

7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.

8. Sensitivity: Field adjustable.

9. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.

C. Wall Switch Occupancy Sensors:

1. General Requirements:

a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.

b. Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.

c. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.

d. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.

D. Ceiling Mounted Occupancy Sensors:

1. General Requirements:

a. Description: Low profile occupancy sensors designed for ceiling installation.

b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.

c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

d. Finish: White unless otherwise indicated.

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.

2.3 TIME SWITCHES

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
3. Or Approved equal.

B. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
   a. Astronomic Time Switches: 8 channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Output Switch Configuration: SPST dry unpowered maintained contacts.
9. Output Switch Contact Ratings:
   a. Resistive Load: Not less than 30 A at 120-277 V ac.
   b. Motor Load: Not less than 1 HP at 120 V ac or 2 HP at 240 V ac.
10. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
    a. Indoor clean, dry locations: Type 1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 0534.

C. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 26 0519 for control wiring conductors, wiring methods, and identification requirements.

D. Install lighting control devices in accordance with manufacturer's instructions.

E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Install lighting control devices plumb and level, and held securely in place.

G. Where required and not furnished with lighting control device, provide wall plate; see Section 26 2726.

H. Provide required supports; see Section 26 0529.

I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

J. Occupancy Sensor Locations:

1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.

2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

3.3 FIELD QUALITY CONTROL

A. Inspect each lighting control device for damage and defects.

B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.

C. Test time switches to verify proper operation.

D. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.4 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

3.5 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of installed lighting control devices.
3. Location: At project site.

END OF SECTION

SECTION 26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.2 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

B. IEEE C2 - National Electrical Safety Code(R) (NESC(R)).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NFPA 70 - National Electrical Code.

1.3 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:

1. Verify the following with Utility Company representative:
    a. Utility Company requirements, including division of responsibility.
    b. Exact location and details of utility point of connection.
    c. Utility easement requirements.
    d. Utility Company charges associated with providing service.
2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:

1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.4 QUALITY ASSURANCE

A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics:

1. Service Type: Underground.
2. Service Voltage: 480Y/277 V, 3 phase, 60 Hz.

C. Utility Company: Rocky Mountain Power.

D. Division of Responsibility:

1. Pad-Mounted Utility Transformers:
   a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
   b. Transformers: Furnished and installed by Utility Company.
   c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
   d. Primary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Utility Company.
   e. Secondary:
      1) Trenching and Backfilling: Provided by Contractor.
      2) Conduits: Furnished and installed by Contractor.
      3) Conductors: Furnished and installed by Contractor (Service Point at transformer).

2. Terminations at Service Point: Provided by Utility Company.
3. Metering Provisions:
    a. Meter Bases: Furnished and Installed by the Contractor.
    b. Metering Compartments in Service Entrance Equipment: Furnished and installed by the Contractor.
    c. Metering Transformers: Furnished and installed by the Contractor.
    d. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment components in accordance with Section 26 0529.

E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.3 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General purpose transformers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.3 SUBMITTALS

A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:

1. Altitude: Less than 3,300 feet.

2. Ambient Temperature:

a. Greater than 10 kVA: Not exceeding 104 degrees F.

b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:

1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

F. Winding Taps:

1. Less than 3 kVA: None.
2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

H. Sound Levels: Standard sound levels complying with NEMA ST 20

I. Mounting Provisions:

1. Less than 15 kVA: Suitable for wall mounting.
2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Outdoor locations: Type 3R.
2. Construction: Steel.
   a. Less than 15 kVA: Totally enclosed, non-ventilated.
   b. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

K. Accessories:

1. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA EN 10250, type 3R assembly.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

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

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0533, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:

1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.

2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.

3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.

L. Identify transformers in accordance with Section 26 0553.

3.2 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.3 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 407 - Standard for Installing and Maintaining Panelboards.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less.

F. NFPA 70 - National Electrical Code.

G. UL 67 - Panelboards.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

I. UL 943 - Ground-Fault Circuit-Interrupters.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. See Section 26 0010 - General Electrical Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Siemens Industry, Inc: www.usa.siemens.com.

D. Square D: www.schneider-electric.com

E. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature:

a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Mains: Configure for top or bottom incoming feed as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

2. Boxes: Galvanized steel unless otherwise indicated.

a. Provide wiring gutters sized to accommodate the conductors to be installed.

b. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.

3. Fronts:

a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.

b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

K. Load centers are not acceptable.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.

2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase and Neutral Bus Material: Copper.

2. Ground Bus Material: Copper.

D. Circuit Breakers:

1. Provide bolt-on type.

2. Provide thermal magnetic circuit breakers unless otherwise indicated.

3. Molded Case Circuit Breakers with integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.

2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase and Neutral Bus Material: Copper.
2. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
1. Type SWD for lighting circuits.
2. Type HACR for air conditioning equipment circuits.
3. Class A ground fault interrupter circuit breakers where scheduled.

E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated on drawings
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
a. Provide mechanical lugs unless otherwise indicated.
b. Lug Material: Copper, suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

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

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 26 0526.
    1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
    2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

K. Install all field-installed branch devices, components, and accessories.

L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

N. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

O. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

P. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

Q. Provide filler plates to cover unused spaces in panelboards.

R. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Fire detection and alarm circuits.
2. Communications equipment circuits.
3. Intrusion detection and access control system circuits.
4. Video surveillance system circuits.

S. Identify panelboards in accordance with Section 26 0553.

T. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.

1. Description included on electrical panel schedules are for design purposes only. Description printed on final panel schedules must have a sufficient degree of detail that allows each circuit to be distinguished from all others, as approved by the Authority Holding Jurisdiction.

U. Provide identification nameplate for each panelboard in accordance with Section 26 0553.

V. Provide arc flash warning labels in accordance with NFPA 70.

W. Provide floor markings to clearly indicate required working clearances where indicated or where required by the authority having jurisdiction.

3.2 FIELD QUALITY CONTROL

A. Test GFCI circuit breakers to verify proper operation.

B. Test shunt trips to verify proper operation.

C. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.3 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.4 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates and covers.

E. Poke-through assemblies.

1.2 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

E. NEMA WD 1 - General Color Requirements for Wiring Devices.

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

G. NFPA 70 - National Electrical Code.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.4 SUBMITTALS

A. See Section 26 0010 - General Electrical Requirements for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Operation and Maintenance Data:

1. Wall Dimmers: Include information on operation and setting of presets.

2. GFCI Receptacles: Include information on status indicators.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.

C. Wiring Device Applications:

1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.

2. Provide GFCI protection for:

a. Receptacles installed within 6 feet of sinks.

b. Receptacles installed in kitchens.

c. Receptacles serving electric drinking fountains.

d. Receptacles serving vending machiines.

3. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.

D. Wiring Device Finishes:

1. Provide wiring device finishes as described below, unless otherwise indicated.

2. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

3. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.

4. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
5. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.
6. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
7. Flush Poke-Through Service Fittings: Gray wiring devices with _____ nonmetallic cover and flange.

2.2 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc: www.leviton.com.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
   4. Or Approved equal.

B. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.3 WALL DIMMERS

A. Manufacturers:
   1. Leviton Manufacturing Company, Inc: www.leviton.com.
   2. Wattstopper, a brand of Legrand: www.legrand.us/wattstopper
   3. Or Approved equal.

B. General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C. Control: Slide control type with separate on/off switch.

D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

E. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.4 RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
4. Or Approved equal.

B. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
3. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
4. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
2. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
3. Tamper Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
4. Tamper Resistant and Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.5 WALL PLATES AND COVERS

A. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

D. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.6 POKE-THROUGH ASSEMBLIES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Wiremold, a brand of Legrand North America, Inc: www.legrand.us
3. Or Approved equal.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

C. Flush Floor Service Fittings:

1. Dual Service Flush Combination Outlets:
   a. Cover: Hinged door(s).
   b. Configuration:
      1) Power: See drawings for number of standard convenience duplex receptacle(s).
      2) Voice and Data Jacks: As specified in Section 27 1000.
2. Accessories:
   a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0534 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:
    a. Wall Switches: 48 inches above finished floor.
    b. Wall Dimmers: 48 inches above finished floor.
    c. Receptacles: 18 Inches above finished floor or 6 inches above counter, or 2" above backsplash.
    d. Install Individual Telephone or Data outlet 18 Inches above finished floor.
    e. Install Combo Tele/Data outlet 18 Inches above finished floor.
2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

Q. Connect wiring device grounding terminal to outlet box with bonding jumper.

R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

S. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

T. Install protective rings on active flush cover service fittings.

U. All non-locking type, 125V, 15A and 20A rated receptacles located in public access areas shall be listed as Tamper Resistant.

V. For all dedicated EWC receptacle, EC to rough-in behind water cooler shroud so no cords or plugs are visible when shroud is installed.

3.4 FIELD QUALITY CONTROL

A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch with circuit energized to verify proper operation.

D. Verify that each receptacle device is energized.

E. Test each receptacle to verify operation and proper polarity.

F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

C. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses.

D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    a. Fusible Enclosed Switches: See Section 26 2816.
    b. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.

B. Littelfuse, Inc: www.littelfuse.com.

C. Or Approved equal.

2.2 APPLICATIONS

A. Service Entrance:

1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Individual Motor Branch Circuits: Class RK1, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 2813 - Fuses.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

H. NFPA 70 - National Electrical Code.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

K. UL 98 - Enclosed and Dead-Front Switches.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

C. Project Record Documents: Record actual locations of enclosed switches.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Approved equal.

F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Minimum Ratings:

a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:

1. Comply with NEMA BS 31047.

2. Conductor Terminations:

a. Provide mechanical lugs unless otherwise indicated.

b. Lug Material: Copper, suitable for terminating copper conductors only.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

O. Provide the following features and accessories where indicated or where required to complete installation:

1. Hubs: As required for environment type; sized to accept conduits to be installed.

2. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where a remote disconnect is on the load side of a variable speed/frequency motor drive, ec to provide auxilary contacts with break sensing to signal drive to switch to coast-to-stop mode. Control wiring and programming provided by supplier of drive.

3.2 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.3 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
   1. Manual motor starters.
   2. Motor-starting switches without overload protection.
B. Overcurrent protective devices for motor controllers, including overload relays.
C. Control accessories:
   1. Auxiliary contacts.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
C. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.
D. NFPA 70 - National Electrical Code.
E. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.
F. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
   3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. See Section 26 0010 - General Electrical Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com.

C. Rockwell Automation, Inc.; Allen-Bradley Products: ab.rockwellautomation.com.

D. Siemens: www.sea.siemens.com.

E. Square D: www.schneider-electric.com.

F. Or Approved equal.

G. Source Limitations: Provide enclosed motor controllers and associated components produced by single manufacturer and obtained from single supplier.

1. Motor-starting switches without overload protection may be produced by same manufacturer as wiring devices used for project.

2.2 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:

1. Provide controllers and associated components suitable for operation under the following service conditions without derating:

a. Altitude:

1) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.

b. Ambient Temperature: Between 32 degrees F and 104 degrees F.

2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:

1. Comply with NEMA IA 10030.

2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1 or Type 12.

b. Outdoor Locations: Type 3R or Type 4.

3. Finish: Manufacturer's standard unless otherwise indicated.

H. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).

2. Configuration: Non-reversing unless otherwise indicated.

3. Fractional-Horsepower Manual Motor Starters:

a. Furnish with toggle operator.

b. Overload Relays: Bimetallic or melting alloy thermal type.

c. Provide means for locking operator in the OFF position.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
    a. Employ manual reset unless otherwise indicated.
    b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
    a. Interchangeable current elements/heaters.
    b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
    c. Trip test function.
7. Melting Alloy Thermal Overload Relays:
    a. Interchangeable current elements/heaters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

J. Identify enclosed controllers in accordance with Section 26 0553.

K. Provide identification nameplate for each panelboard in accordance with Section 26 0553.

L. Provide neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder

M. Provide arc flash warning labels in accordance with NFPA 70.

N. Where a remote disconnect is on the load side of a variable speed/frequency motor drive, ec to provide auxilary contacts with break sensing to signal drive to switch to coast-to-stop mode. Control wiring and programming provided by supplier of drive.

3.2 FIELD QUALITY CONTROL

A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B. Perform applicable inspections and tests listed in NETA STD ATS, except Section 4

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

D. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

3.3 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 3213 - ENGINE GENERATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:

1. Engine and engine accessory equipment.
2. Alternator (generator).
3. Generator set control system.
4. Generator set enclosure.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 3600 - Transfer Switches.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA/EGSA 404 - Standard for Installing Generator Sets.

C. NEMA MG 00001 - Motors and Generators.

D. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

E. NFPA 70 - National Electrical Code.

F. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries.

G. UL 2200 - Stationary Engine Generator Assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
2. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 26 00 10 - General Electrical Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.

C. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

D. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

F. Manufacturer's factory emissions certification.

G. Manufacturer's certification that products meet or exceed specified requirements.

H. Source quality control test reports.

I. Manufacturer’s detailed field testing procedures.

J. Field quality control test reports.

K. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

L. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

M. Maintenance contracts.

N. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

O. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Filter Elements: Two of each type, including fuel, oil and air.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1. Authorized service facilities located within 200 miles of project site.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 WARRANTY

A. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Packaged Engine Generator Set:

1. Generac Power Systems: www.generac.com/industrial/#sle.

2. Or acceptable equal.

2.2 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:

1. Application: Optional Standby.
2. Configuration: Single packaged engine generator set operated independently (not in parallel).

D. Packaged Engine Generator Set:

1. Type: Gaseous (spark ignition).
2. Power Rating: 100 kW, standby. Site rated.
3. Voltage: 208Y/120 V, 3 phase, 60 Hz.
4. Main Line Circuit Breaker:
    a. Type: Thermal magnetic.
    b. Trip Rating: 300 amps.

E. Generator Set General Requirements:

1. Factory-assembled, with components mounted on suitable base.
2. List and label engine generator assembly as complying with UL 2200.
3. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
4. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
5. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

1. Altitude: 6400 feet.

G. Starting and Load Acceptance Requirements:

1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds.
4. Maximum Load Step: Supports 100 percent of rated load in one step.
    a. Maximum Voltage Deviation with Load Step: 15 percent.
    b. Maximum Frequency Deviation with Load Step: 12 percent.

H. Exhaust Emissions Requirements:

1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

2.3 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Gaseous (Spark Ignition):
   1. Fuel Source: Natural gas.
   2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
   3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
      a. Carburetor.
      b. Gas pressure regulators.
      c. Fuel shutoff control valves.
      d. Low gas pressure switches.

C. Engine Starting System:
   1. System Type: Electric, with DC solenoid-activated starting motor(s).
   2. Battery(s):
      a. Battery Type: Lead-acid.
      b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
      c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
   3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
   4. Battery Charger:
      a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
      b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.

c. Listed as complying with UL 1236.

d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.

e. Provide integral DC output ammeter and voltmeter with five percent accuracy.

f. Provide alarm output contacts as necessary for alarm indications.

5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):

1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.

2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:

1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.

F. Engine Cooling System:

1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.

2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.

3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:

1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.

2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

2.4 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 00001; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:

1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.

2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 00001, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 00001, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

2.5 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:

1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
2. Generator Set Control Functions:
    a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
    b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
    c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
    d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
    e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
    f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
    g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
3. Generator Set Status Indications:
    a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
    b. Current (Amps): For each phase.
    c. Frequency (Hz).
    d. Real power (W/kW).
    e. Reactive power (VAR/kVAR).
    f. Apparent power (VA/kVA).
    g. Power factor.
    h. Duty Level: Actual load as percentage of rated power.
    i. Engine speed (RPM).

j. Battery voltage (Volts DC).

k. Engine oil pressure.

l. Engine coolant temperature.

m. Engine run time.

n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:

a. Including but not limited to the following protections/indications:

1) Overcrank (shutdown).

2) Low coolant temperature (warning).

3) High coolant temperature (warning).

4) High coolant temperature (shutdown).

5) Low oil pressure (warning).

6) Low oil pressure (shutdown).

7) Overspeed (shutdown).

8) Low fuel level (warning).

9) Low coolant level (warning/shutdown).

10) Generator control not in automatic mode (warning).

11) High battery voltage (warning).

12) Low cranking voltage (warning).

13) Low battery voltage (warning).

14) Battery charger failure (warning).

15) High AC voltage (shutdown).

16) Low AC voltage (shutdown).

17) High frequency (shutdown).

18) Low frequency (shutdown).

19) Overcurrent (shutdown).

b. Provide contacts for local and remote common alarm.

c. Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:

a. Event log.

b. Communications Capability: Utilize Modbus communications protocol. Provide all accessories necessary for proper interface.

C. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.6 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

J. The enclosure shall be provided with a load center to power all generator accessories.

   1. 125A main lugs.
   2. Single phase, copper bus.
   3. Moutned on genset frame near control panel/display unit.

K. The enclosure shall be provided with a single 20A, 120V duplex service receptacle.

2.7 SOURCE QUALITY CONTROL

A. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

B. Generator Set production testing to include, at a minimum:

   1. Operation at rated load and rated power factor.
   2. Single step load pick-up.
   3. Transient and steady state voltage and frequency performance.
   4. Operation of safety shutdowns.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

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

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch high concrete pad constructed in accordance with the drawings.

F. Provide required support and attachment in accordance with Section 26 0529.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Do not insulate piping for engine components restricted by manufacturer.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Identify system wiring and components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

E. Preliminary inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.
2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
3. Check for proper oil and coolant levels.

F. Prepare and start system in accordance with manufacturer's instructions.

G. Inspection and testing to include, at a minimum:

1. Verify compliance with starting and load acceptance requirements.
2. Verify voltage and frequency; make required adjustments as necessary.

3. Verify phase sequence.
4. Verify control system operation, including safety shutdowns.
5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).

H. Provide field emissions testing where necessary for certification.

I. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Instructor: Manufacturer's authorized representative.
3. Location: At project site.

C. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.6 MAINTENANCE

A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Automatic Transfer Switch.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 3213 - Engine Generators: For interface with transfer switches.

1. Includes additional testing requirements.

2. Includes related demonstration and training requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 1008 - Transfer Switch Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.

a. Engine Generators: See Section 26 3213.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

B. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

C. Specimen Warranty: Submit sample of manufacturer's warranty.

D. Evidence of qualifications for installer.

E. Manufacturer's certification that products meet or exceed specified requirements.

F. Manufacturer’s detailed field testing procedures.

G. Field quality control test reports.

H. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

I. Maintenance contracts.

J. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

K. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

L. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

M. Operation Data: Instructions for operating equipment under emergency conditions when engine generator is running.

N. Maintenance Data: Routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1. Authorized service facilities located within 200 miles of project site.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.

D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.8 WARRANTY

A. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. The automatic transfer switch shall be furnished by the manufacturer of the engine-generator set so as to maintain system compatibility and local service responsibility for the complete emergency power system. It shall be listed by Underwriter's Laboratory, Standard 1008 with fuse or circuit breaker protection. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 312.6. The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.

2.2 RATINGS AND PERFORMANCE

A. Transfer Switches:

1. Schneider Electric; ASCO Power Technologies: www.ascopower.com/#sle.

2. Same as manufacturer of engine generator(s) used for this project.

B. The automatic transfer switch shall be a 3 pole design rated as scheduled continuous operation in ambient temperatures of -20 degrees Fahrenheit (-30 degrees Celsius) to +140 degrees Fahrenheit (+60 degrees Celsius). Main power switch contacts shall be rated for 600 V AC minimum. The transfer switch supplied shall have a minimum withstand and closing rating when fuse protected of 200,000 amperes. Where the line side overcurrent protection is provided by circuit breakers, the short circuit withstand and closing ratings shall be 42,000 amperes RMS. These RMS symmetrical fault current ratings shall be the rating listed in the UL listing or component recognition procedures for the transfer switch. All withstand tests shall be performed with the overcurrent protective devices located external to the transfer switch.

C. CONSTRUCTION

1. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses .

2. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy with arc chutes to resist burning and pitting for long life operation.

D. SERVICE CONDITIONS

1. Service Conditions: NEMA ICS 10.

2. Altitude: 6,400 feet.

E. COMPONENTS

1. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.

2. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific application needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down system voltage of 120/208 vac 3 phase to 24VAC, helping to protect the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.

3. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start, adjustable, .1 to 10 seconds, shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
4. Transfer the load to the engine-generator set after it reached proper voltage, adjustable from 70-90% of system voltage, and frequency, adjustable from 80-90% of system frequency. A solid state time delay, adjustable from 5 seconds to 3 minutes, shall delay this transfer to allow the engine-generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.
5. Retransfer the load to the line after normal power restoration. A return to utility timer, adjustable from 1-30 minutes, shall delay this transfer to avoid short term normal power restoration.
6. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
7. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cooldown timer, adjustable from 1-30 minutes, shall permit the engine to run unloaded to cooldown before shutdown. Should the utility power fail during this time, the switch will immediately transfer back to the generator.
8. Provide an engine minimum run timer, adjustable from 5-30 minutes, to ensure an adequate engine run period.
9. The transfer switch shall have a time delay neutral feature to provide a time delay, adjustable from .1-10 seconds, during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. A switch will be provided to bypass all transition features when immediate transfer is required.
10. The transfer switch shall have an inphase monitor which allows the switch to transfer between live sources if their voltage waveforms become synchronous within 20 electrical degrees within 10 seconds of transfer initiation signal. A switch must be provided to bypass this feature if not required.
11. If the inphase monitor will not allow such a transfer, the control must default to time delay neutral operation. Switches with inphase monitors which do not default to time delay neutral operation are not acceptable.
12. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.
13. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
14. Provide manual operating handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure so accessible only by authorized personnel.

15. Provide a maintenance disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
16. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warm-up, standby ready, transfer to standby, inphase monitor, time delay neutral, return to utility, engine cooldown and engine minimum run. A "signal before transfer" lamp shall be supplied to operate from optional circuitry.
17. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate source to normal source.
18. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
19. Enclosure: ICS 10, Type 1, finished with manufacturer's standard gray enamel.
20. Provide inhibit or permit shed function.

F. AUTOMATIC SEQUENCE OF OPERATION

1. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
2. Time Delay To Start Alternate Source Engine Generator: 0 to 10 seconds, adjustable.
3. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
4. Time Delay Before Transfer to Alternate Power Source: 0 to 180 seconds, adjustable.
5. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
6. Time Delay Before Transfer to Normal Power: 0 to 1800 seconds, adjustable; bypass time delay in event of alternate source failure.
7. Time Delay Before Engine Shut Down: 0 to 1800 seconds, adjustable, of unloaded operation.
8. Engine Exerciser: Programmable electronic exerciser clock control to start engine on a weekly cycle. Clock must allow any combination of 30 days and time of day; run for selectable amount of minutes before shutting down. Bypass exerciser control if normal source fails during exercising period. Battery backed settings and operation
9. Alternate System Exerciser: Selectable switch to transfer load to alternate source during engine exercising period as an option.

2.3 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Construction Type: Only "contactor type" (open contact) transfer switches are acceptable. Do not use "breaker type" (enclosed contact) transfer switches.

C. Comply with NEMA IA 10042-1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

D. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

E. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

F. Switching Methods:

1. Open Transition:

a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.

b. Where in-phase transfer is indicated, utilize in-phase monitor to initiate transfer when phase angle difference between sources is near zero to limit in-rush currents.

2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

G. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

H. Enclosures:

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1 or Type 12.

b. Outdoor Locations: Type 3R or Type 4.

2. Finish: Manufacturer's standard unless otherwise indicated.

I. Short Circuit Current Rating:

1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

J. Automatic Transfer Switches:

1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.

2. Control Functions:

a. Automatic mode.

b. Test Mode: Simulates failure of primary/normal source.

c. Voltage and Frequency Sensing:

1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.

2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.

3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.

d. Outputs:

1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).

2) Auxiliary contacts; one set(s) for each switch position.

e. Adjustable Time Delays:

1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.

2) Transfer to alternate/emergency source time delay.

3) Retransfer to primary/normal source time delay.

4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.

f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.

g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.

3. Status Indications:

a. Connected to alternate/emergency source.

b. Connected to primary/normal source.

c. Alternate/emergency source available.

4. Automatic Sequence of Operations:

a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.

b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.

c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.

d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

K. Interface with Other Work:

1. Interface with engine generators as specified in Section 26 3213.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

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

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install transfer switches plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Automatic Transfer Switches:

1. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

D. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 26 3213.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

G. Provide the services of the manufacturer's technical representative to check out transfer switch connections and operation and place in service.

H. Perform field inspection and testing in accordance with Section 01 4000.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

C. Coordinate with related generator demonstration and training as specified in Section 26 3213.

D. Demonstrate operation of transfer switch in bypass, normal, and emergency modes.

3.6 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

3.7 MAINTENANCE

A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION

SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices for distribution locations.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 2416 - Panelboards.

1.3 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NFPA 70 - National Electrical Code.

E. UL 1449 - Standard for Surge Protective Devices.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.5 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. UL 1449.

C. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

E. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

F. Project Record Documents: Record actual connections and locations of surge protective devices.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.8 WARRANTY

A. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Field-Installed, Externally Mounted Surge Protective Devices:

1. Schneider Electric; Square D Brand Surgelogic Products: www.surgelogic.com/#sle.
2. Approved equal.

B. Factory-installed, Internally Mounted Surge Protective Devices:

1. Same as manufacturer of equipment containing surge protective device, to provide complete listed assembly including SPD.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mouonted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:

1. Wye Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):

1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

2. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

1. Indoor clean, dry locations: Type 1.

2. Outdoor locations: Type 3R.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:

1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

I. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

1. Panelboards: See Section 26 2416.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular or non-modular.

2. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

3. UL 1449 Nominal Discharge Current (I-n): 20 kA.

4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

5. Diagnostics:

a. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.

b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

c. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.

d. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

6. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Distribution locations include SPDs connected to distribution panelboards.

B. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular or non-modular.

2. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.

3. UL 1449 Nominal Discharge Current (I-n): 20 kA.

4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

5. Diagnostics:

a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.

b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

c. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

6. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.5 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular or non-modular.

2. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.

3. UL 1449 Nominal Discharge Current (I-n): 20 kA.

4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

5. Diagnostics:

a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.

b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

c. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

C. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

D. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

E. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

F. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

G. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Drivers.

E. Lamps.

1.2 REFERENCE STANDARDS

A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

D. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 101 - Life Safety Code.

G. UL 924 - Emergency Lighting and Power Equipment.

H. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.

4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.4 SUBMITTALS

A. See Section 26 00 10 - General Electrical Requirements for submittal procedures.

B. Shop Drawings: Indicate dimensions and components for each fixture that is not a standard product of the manufacturer.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.

D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 WARRANTY

A. Provide five year manufacturer warranty for all LED luminaires, including drivers. Unless a different warranty is listed on the light fixture schedule.

B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS - LUMINAIRES

A. See Light Fixture Schedule on drawings.

B. Or Approved Equal.

2.2 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.3 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:

1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

G. Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.5 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.

2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

1. Self-Powered Exit Signs:

a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

b. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

c. Provide low-voltage disconnect to prevent battery damage from deep discharge.

C. Accessories:

1. Provide compatible accessory wire guards where indicated.

2.6 DRIVERS

A. Drivers - General Requirements:

1. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to 10 percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
    a. Wall Dimmers: See Section 26 2726.

2.7 LAMPS

A. Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

B. LED:

1. Light Loss: L70 equal to or greater than 50,000 hrs.
2. Color temperature of 4,000k.
3. Color Shift within a 3-step MacAdams ellipse.
4. Luminaire performance based on 25 degree ambient temperature.
5. Power Factor greater .85 or better.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0534 as required for installation of luminaires provided under this section.

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

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship).

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.
2. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
3. Secure pendant-mounted luminaires to building structure.
4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

G. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
4. Install canopies tight to mounting surface.

I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

J. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

K. Surface Mounted Fixtures: Install plumb and square and aligned with building lines and with each other; secure to prevent movement.

L. Wall Mounted Fixtures: Install at height as indicated on the drawings.

M. Locate recessed ceiling luminaires as indicated on lighting plans.

N. Install accessories furnished with each luminaire.

O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture.

P. Bond products and metal accessories to branch circuit equipment grounding conductor.

Q. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

R. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

3.2 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.3 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Owner. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

D. Aim and adjust fixtures as indicated.

3.4 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean finishes and touch up damage.

3.5 CLOSEOUT ACTIVITIES

A. Just prior to Substantial Completion, replace all lamps that have failed.

END OF SECTION

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires.

B. Ballasts.

C. Lamps.

D. Poles and accessories.

1.2 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)).

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems.

F. NFPA 70 - National Electrical Code.

G. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.

2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

3. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.4 SUBMITTALS

A. See Section 26 00 10 - General Electrical Requirements for submittal procedures.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting

requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
    a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

E. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.6 WARRANTY

A. Provide 5-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule .

2.2 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 DRIVERS

A. Drivers - General Requirements:

1. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.4 LAMPS

A. Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

B. LED:

1. Light Loss: L70 equal to or greater than 50,000 hrs.
2. Color temperature of 4,000k.
3. Color Shift within a 3-step ellipse.
4. Luminaire performance based on 25 degree ambient temperature.

2.5 POLES

A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:

a. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.

1) Design Wind Speed: 100 miles per hour, with gust factor of 1.3.

3. Material: Steel and Wood, unless otherwise indicated.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
   a. Top cap.
   b. Handhole.
   c. Anchor bolts with leveling nuts or leveling shims.

B. Metal Poles: Provide ground lug, accessible from handhole.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0534 as required for installation of luminaires provided under this section.

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

C. Install luminaires in accordance with NECA/IESNA 501.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

G. Pole-Mounted Luminaires:
   1. Maintain the following minimum clearances:
      a. Comply with IEEE C2.
      b. Comply with utility company requirements.
   2. Foundation-Mounted Poles:
      a. Provide cast-in-place concrete foundations for poles as indicated.
         1) Install anchor bolts plumb per template furnished by pole manufacturer.
         2) Position conduits to enter pole shaft.
      b. Install foundations plumb.
      c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
      d. Tighten anchor bolt nuts to manufacturer's recommended torque.

e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.

f. Install anchor base covers or anchor bolt covers as indicated.

3. Grounding:

a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.

4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

H. Install accessories furnished with each luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Architect.

3.3 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.4 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean finishes and touch up damage.

3.5 CLOSEOUT ACTIVITIES

A. Just prior to Substantial Completion, replace all lamps that have failed.

END OF SECTION

DIVISION

27

COMMUNICATIONS

SECTION 27 1000 - STRUCTURED CABLING AND EQUIPMENT FOR VOICE AND DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Communications pathways.

B. Copper cable and terminations.

C. Fiber optic cable and interconnecting devices.

D. Communications equipment room fittings.

E. Communications outlets.

F. Communications grounding and bonding.

G. Communications identification.

H. Telecommunications service entrance to building(s).

I. Cabling and pathways inside building(s).

J. Distribution frames, cross-connection equipment, enclosures, and outlets.

K. Grounding and bonding the telecommunications distribution system.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0536 - Cable Trays for Electrical Systems.

C. Section 26 0534 - Boxes for Electrical Systems.

D. Section 26 2726 - Wiring Devices.

1.3 REFERENCE STANDARDS

A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.

B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment.

C. EIA-310 - Cabinets, Racks, Panels, and Associated Equipment; Electronic Industries Association; Revision D, 1992.

D. NFPA 70 - National Electrical Code.

E. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set.

F. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

G. TIA-569 - Telecommunications Pathways and Spaces.

H. TIA-606 - Administration Standard for Telecommunications Infrastructure.

I. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

J. TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements.

K. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

L. TIA-569-D - Telecommunications Pathways and Spaces.

M. TIA-606-B - Administration Standard for Telecommunications Infrastructure.

N. ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

O. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

P. UL 1863 - Communications-Circuit Accessories.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used (Cables, Racks, Switches, Outlets, etc.).

1. Storage and handling requirements and recommendations.
2. Installation methods.

B. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.

C. Field Test Reports.

D. Project Record Documents:

1. Record actual locations of outlet boxes and distribution frames.
2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
3. Identify distribution frames and equipment rooms by room number on drawings.

E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:

1. Supervisors and installers factory certified by manufacturers of products to be installed.
2. Employing experienced technicians for all work; show at least 3 years experience in the installation of the type of system specified, with evidence from at least 2 projects that have been in use for at least 18 months; submit project name, address, and written certification by user.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep stored products clean and dry.

1.8 WARRANTY

A. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cabling:

1. Belden
2. Westpenn. www.westpenn-wpw.com/
3. Avaya. www.avaya.com/
4. General Cable. www.generalcable.com/
5. Systimax. www.commscope.com/
6. Acceptable Equal

B. Equipment:

1. Panduit. www.panduit.com/
2. Systimax. www.commscope.com/
3. Integrated Communications Cabling (ICC). www.icc.com/
4. Acceptable Equal

2.2 SYSTEM DESIGN

A. Provide a complete, permanent system of cabling and pathways for voice and data communications, including conduits and wireways, pull wires, support structures, enclosures and cabinets.

1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
2. Provide fixed conduits and pathways that comply with NFPA 70 and ANSI/J-STD-607 and are UL listed or third party independent testing laboratory certified.
3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
5. Provide a separate cable for every jack indicted, both in single and multiple jack outlet combinations.

B. System Description:
1. Building Entrance Cable: By others.
2. Backbones - Within Building: Fiber Optic, 12-fiber.
3. Horizontal Cabling: Copper.

C. Main Distribution Frame (MDF): Centrally located support structure for terminating backbone cables and horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
1. Locate main distribution frame as indicated on the drawings..
2. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.

D. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
1. Locate intermediate distribution frames as indicated on the drawings.
2. As required to terminate all cables required by design criteria plus minimum 25 percent spare space.

E. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.

F. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.3 PATHWAYS

A. Conduit: As specified in Section 26 05 34.
1. Provide pull cords in all empty conduit

B. Cable Trays: See Section 26 0536.

C. Underground Service Entrance: Rigid polyvinyl chloride (PVC) conduit, Schedule 40.

D. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

2.4 COPPER CABLE AND TERMINATIONS

A. Copper Horizontal Cable:

1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
2. Cable Type - Voice and Data: TIA-568 Category 6A UTP (unshielded twisted pair); 23 AWG.
3. Cable Capacity: 4-pair.
4. Cable Applications:
    a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
    b. General Purpose Applications: Use listed NFPA 70 Type CM/CMG general purpose cable, Type CMR riser cable, or Type CMP plenum cable.
5. Cable Jacket Color - Voice and Data Cable: Blue.

B. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.

1. Performance: 750 mating cycles.
2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.

C. Copper Patch Cords:

1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
2. Patch Cords for Patch Panels:
    a. Quantity: One for each pair of patch panel ports.
    b. Length: 50% 3 feet, 50% 5 feet.

2.5 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES

A. Fiber Optic Backbone Cable:

1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, TIA-598, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
2. Cable Type: Multimode, laser-optimized 50/125 um (OM4) complying with TIA-492AAAD.
3. Cable Capacity: 12 -fiber.
4. Cable Applications:
    a. Plenum Applications: Use listed NFPA 70 Type OFNP plenum cable.
5. Cable Jacket Color:
    a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.
6. Aluminum interlock armor

B. Fiber Optic Interconnecting Devices:

1. Connector Type: Type LC.
2. Connector Performance: 500 mating cycles, when tested in accordance with TIA-455-21.
3. Maximum Attenuation/Insertion Loss: 0.3 dB.

C. Fiber Optic Adapters and Connectors: Duplex SC, push-on-push-off type, single mode adaptors with zirconia ceramic alignment sleeves; complying with relevant parts and addenda to latest edition of TIA/EIA-568 and with maximum attenuation of 0.3 dB at 1300 nm with less than 0.2 dB change after 500 mating cycles when tested in accordance with TIA-455-21.

2.6 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Copper Cross-Connection Equipment:

1. Connector Blocks for Category 6A Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.
2. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
    a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
    b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
    c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
    d. Provide incoming cable strain relief and routing guides on back of panel.

B. Fiber Optic Cross-Connection Equipment:

1. Patch Panels for Fiber Optic Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum.
    a. Adapters: As specified above under FIBER OPTIC CABLE AND INTERCONNECTING DEVICES; maximum of 24 duplex adaptors per standard panel width.
    b. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
    c. Provide incoming cable strain relief and routing guides on back of panel.
    d. Provide rear cable management tray at least 8 inches deep with removable cover.
    e. Provide dust covers for unused adapters.

C. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.

1. Size: 48 by 96 inches.
2. Do not paint over UL label.

D. Equipment Frames, Racks and Cabinets:

1. Component Racks: EIA/ECA-310 standard 19 inch wide.
2. Floor Mounted Racks: Steel construction with corrosion resistant finish; vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug, square hole.

2.7 COMMUNICATIONS OUTLETS

A. Outlet Boxes: Comply with Section 26 0534.
   1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
   2. Minimum Size, Unless Otherwise Indicated:
      a. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.

B. Wall Plates:
   1. Comply with system design standards and UL 514C.
   2. Accepts modular jacks/inserts.
   3. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26 2726.

2.8 GROUNDING AND BONDING COMPONENTS

A. Comply with TIA-607.

2.9 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

2.10 ACCESSORIES

A. Hook-and-Loop Cable Ties:
   1. Description: Single-component, self-engaging fastener with hook on one side and engageable loop backing.
   2. Cable Ties Installed in Spaces Used for Environmental Air: Fire retardant; plenum rated, listed as suitable for use in air-handling spaces.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

B. Comply with Communication Service Provider requirements.

C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

3.2 INSTALLATION OF PATHWAYS

A. Underground Service Entrance: Install conduit at least 24 inches below finish grade; encase in at least 3 inches thick concrete for at least 60 inches out from the building line. Provide foil backed warning tape in trench from building line to utility pedestal.

B. Install pathways with the following minimum clearances:

1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
2. 12 inches from power conduits and cables and panelboards.
3. 5 inches from fluorescent and high frequency lighting fixtures.
4. 6 inches from flues, hot water pipes, and steam pipes.

C. Minimum Cover - Underground Service Entrance: Comply with NFPA 70 and Communications Service Provider requirements.

D. Conduit:

1. Provide conduit in all inaccessible areas, crawlspaces, walls, and where exposed to view unless indicated below.
    a. Do not install more than 2 (two) 90 degree bends in a single horizontal cable run.
    b. Leave pull cords in place where cables are not initially installed.
    c. Conceal conduit under floor slabs and within finished walls, ceilings, and floors except where specifically indicated to be exposed.
        1) Conduit may remain exposed to view in mechanical rooms, electrical rooms, and telecommunications rooms.
        2) Treat conduit in crawl spaces and under floor slabs as if exposed to view.
        3) Where exposed to view, install parallel with or at right angles to ceilings, walls, and structural members.
        4) Under floor slabs, locate conduit at 12 inches, minimum, below vapor retarder; seal penetrations of vapor retarder around conduit.

E. Outlet Boxes:

1. Coordinate locations of outlet boxes provided under Section 26 0534 as required for installation of telecommunications outlets provided under this section.
    a. Mounting Heights: Unless otherwise indicated, as follows:
        1) Telephone and Data Outlets: 18 inches above finished floor.
    b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
    c. Locate outlet boxes so that wall plate does not span different building finishes.
    d. Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

2. Cable trays, D-rings, J-hooks, cable troughs:

    a. Provide cable trays, D-rings, J-hooks, or cable troughs unless shown otherwise in plenums accessible ceilings, and areas not exposed to view.

    b. Provide cable trays where indicated on drawings.

3.3 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
2. Do not over-cinch or crush cables.
3. Do not exceed manufacturer's recommended cable pull tension.
4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:

1. At Distribution Frames: 60 inches.
2. At Outlets - Copper: 12 inches.

C. Copper Cabling:

1. Category 5e/6/6A: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
3. Use T568B wiring configuration.
4. Copper Cabling Not in Conduit: Use only type CMP plenum-rated cable as specified.
5. For all cable, provide NFPA 70 type CMP plenum-rated cable.

D. Fiber Optic Cabling:

1. Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
2. Support vertical cable at intervals as recommended by manufacturer.

E. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.

1. Prior to installing distribution racks and equipment, EC to review and coordinate layout plan with owner personnel.
2. Identification:

    a. Use wire and cable markers to identify cables at each end.

    b. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.

c. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

F. Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.

1. Cables: Install color coded labels on both ends.

2. Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.

3. Patch Panels: Label each jack as to its type and function, with a unique numerical identifier.

G. Install all equipment listed above in racks at locations coordinated by owner IT representative.

3.4 FIELD QUALITY CONTROL

A. EC to provide all testing. Comply with inspection and testing requirements of specified installation standards.

B. Visual Inspection:

1. Inspect cable jackets for certification markings.

2. Inspect cable terminations for color coded labels of proper type.

3. Inspect outlet plates and patch panels for complete labels.

C. Testing - Copper Cabling and Associated Equipment:

1. Test backbone cables after termination but before cross-connection.

2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.

3. Test operation of shorting bars in connection blocks.

4. Category 6A Backbone: Perform near end cross talk (NEXT) and attenuation tests.

5. Category 6A Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

D. Testing - Fiber Optic Cabling:

1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.

2. Multimode Backbone: Perform tests in accordance with TIA-526-14.

3. Links: Perform optical fiber end-to-end attenuation tests and field reel tests.

E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

1. Provide a copy of the fiber optic certification with the O&M manuals.

2. Provide a copy of the copper certification with the O&M manuals.

END OF SECTION

DIVISION

28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 4600 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

1.2 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authorities having jurisdiction.

B. BAS: Building automation system.

C. DMNS: Distributed mass notification system.

D. ECS: Emergency communications system.

E. EoL: End-of-line.

F. EVACS: Emergency voice/audio communication systems.

G. FACU: Fire alarm control unit.

H. HVAC: Heating, ventilation, and air conditioning.

I. IDC: Initiating device circuit.

J. LAN: Local area network.

K. MNS: Mass notification system.

L. NAC: Notification appliance circuit.

M. NPLFA: Non-power-limited fire alarm.

N. PLFA: Power-limited fire alarm.

O. SLC: Signaling line circuit.

P. SOO: Sequence of operation.

1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

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.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 305 - Standard for Fire Alarm System Job Practices.

F. NFPA 70 - National Electrical Code.

G. NFPA 72 - National Fire Alarm and Signaling Code.

H. NFPA 101 - Life Safety Code.

I. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems.

J. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems.

K. UL 268A - Standard for Smoke Detectors for Duct Application.

L. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.

M. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems.

N. UL 864 - Control Units and Accessories for Fire Alarm Systems.

O. UL 1449 - Standard for Surge Protective Devices.

P. UL 1971 - Standard for Signaling Devices for the Hearing Impaired.

Q. UL 2075 - Standard for Gas and Vapor Detectors and Sensors.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment.
2. Coordinate placement of devices and notification appliances with potential conflicts or view obstructions.
3. Coordinate work to provide power for equipment at required locations (e.g., smoke dampers, type of actuators, line or local control transformer, zoning, grouping and circuit activations).
4. Coordinate fire suppression systemdevice requirements, monitoring, control, and associated interconnections.
5. Coordinate requirements for branch circuit protection, identification, and shunt trip if applicable.
6. Coordinate reflected ceiling plans to avoid conflicting placements; maintain minimum diffuser and detector clearances as indicated.
7. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.
8. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
9. Elevators or Escalators: See Division 14.

B. Sequencing:

1. Verify exact termination locations required for boxes, enclosures, and equipment.

2. Do not install devices or notification appliances until final surface finishes, painting, and cleaning are complete, unless otherwise required by AHJ.
3. Do not begin installation of conductors and cables until installation of conduit and pathways between termination points is complete.
4. Sequence work to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
5. Verify naming convention for equipment identification, including room names and numbers, prior to creation of final drawings, reports, and labels.

1.5 SUBMITTALS

A. See Section 260010 - General Electrical Requirements

B. Evidence of designer qualifications.

C. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.

D. Design Documents: Submit all information required for plan review and permitting by AHJ, including floor plans, riser diagrams, and description of operation.

1. Copy (if any) of list of data required by AHJ.
2. NFPA 72 "Record of Completion", filled out to extent known at time.
3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
5. Certification by manufacturer of FACU that system design complies with Contract Documents.
6. Certification by Contractor that system design complies with Contract Documents.

E. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.

1. System zone boundaries and interfaces to fire safety systems.
2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
3. Include elevations and details of proposed equipment arrangements.
4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
6. Include requirements and control diagrams for interfacing with other systems.

7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.
    a. ECS speaker circuit calculations, including spare capacity.
8. List of devices and notification appliances on each SLC, with spare capacity indicated.
9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
11. Detailed drawing of graphic annunciators, displays, and interfaces.
12. Certification by either FACU manufacturer by manufacturer of related equipment.
13. Certification by FACU manufacturer that system design complies with Contract Documents.
14. Certification by Contractor that system design complies with Contract Documents.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Evidence of installer qualifications.

H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test," filled out.

I. Operating and Maintenance Data: Revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by AHJ.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures require recording of system trouble events by qualified personnel, such as when routine testing is being conducted for fire drills and when entering into contracts for building renovations.

J. Project Record Documents: Have one set available during closeout demonstration:

1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, and updated input/output chart.

K. Closeout Documents:

1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III (three) or Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACU manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.

B. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.

1. Authorized representative of FACU manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least two years of experience installing fire alarm systems.
3. Supervisor: Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.
4. Contract maintenance office located within 300 miles of project site.
5. Certified in the State in which the Project is located as fire alarm installer.

C. Manufacturer Qualifications: Company specialized in manufacturing products specified in this section with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.

B. Handle carefully to avoid damage to internal components, enclosure, and finish.

C. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 WARRANTY

A. Fire Alarm Control Units and Accessory Equipment: Provide minimum 3-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

B. Fire Alarm Manual Pull Stations: Provide minimum 1-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

D. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 FIRE ALARM SYSTEM

A. General Requirements:

1. Provide new fire alarm system complying with NFPA 70, NFPA 72, NFPA 90A, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
    a. 36 CFR 1191 and ADA Standards.
    b. Requirements of State Fire Marshal.
    c. Requirements of AHJ.
    d. Applicable local codes.
    e. Contract Documents.
    f. NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
3. Fire Alarm System Products:
    a. Listed, classified, and labeled as suitable for purpose intended.
    b. Installation Environments: Provide products suitable for their respective indoor and outdoor applications.
4. Fire Alarm System Design Information:
    a. Building Code: Comply with applicable building code.
        1) Principle Occupancy: As indicated on Architect code summary drawings.
        2) Elevators: As indicated on Architect code summary drawings.
        3) Occupant Evacuation Method: Total building.

4) Fire Suppression System: Fully sprinkled.

(a) Types:

(1) Wet-Pipe Sprinklers, Dry-Pipe Sprinklers, and Preaction Sprinkler System.

(b) Elevator Hoistway: Provide detection, actuation, and dedicated annunciation for sprinklered hoistways in accordance with NFPA 72.

b. NFPA 72 Fire Alarm System Classification: Protected premises.

5. Provide fire alarm circuits in accordance with NFPA 70.

a. Comply with methods of interconnecting FACUs in accordance with NFPA 72 and NFPA 70.

b. Power Sources:

1) Comply with requirements for power supplies of emergency systems in accordance with NFPA 70.

2) Primary: Dedicated branch circuits from facility power distribution system.

3) Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.

c. Wiring and Wiring Methods:

1) General Requirements:

(a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.

(b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.

(c) Special Occupancies: Comply with NFPA 70.

(d) Comply with NFPA 70 for wire and cable plenum, riser, general-purpose, limited-use, undercarpet, and underground applications.

2) Fire Alarm Circuits:

(a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.

(b) Non-Power-Limited Fire Alarm (NPLFA) Circuits:

(1) Provide dedicated NPLFA non-GFCI branch circuits for fire alarm equipment and marked by red identification in accordance with NFPA 70.

(c) Power-Limited Fire Alarm (PLFA) Circuits:

(1) Provide identification for PLFA circuits in accordance with NFPA 70.

6. Provide pathway class designations and pathway survivability, as defined in NFPA 72.

a. Provide monitoring of conductors and other signaling channels for integrity and circuit performance.

b. Pathway Class Designations:

1) Unless otherwise indicated or required, pathways to meet the following requirements:

(a) SLCs: Class A (daisy-chain loop, with return).

(b) IDCs: Class A (daisy-chain with return to control source after last device in circuit).

(c) NACs: Class A (daisy-chain with return to control source after last device in circuit).

7. Spare System Capacity:

a. SLCs: Minimum 25 percent spare capacity.

b. NACs: Minimum 25 percent spare capacity.

8. Secondary Power Source - Battery Storage Capacity:

a. Provide standby (nonalarm) operation sufficient for 24 hours.

b. Provide additional alarm operation for 15 minutes.

c. Calculate combined of standby load plus alarm load for overall battery storage capacity requirements, per power supply.

d. Provide 25 percent additional overall battery capacity correction factor.

B. Fire Alarm System Interfaces and Control Functions:

1. UL 864 listed unless otherwise indicated.

2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.

3. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.

4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.

5. Fire Suppression Systems:

a. Provide minimum of six monitoring point inputs per system unless otherwise indicated.

b. Fire Sprinkler Systems:

1) Waterflow Switches: Provide minimum of one monitoring point input per switch.

2) Control Valve Supervisory (Tamper) Switches: Provide minimum of one monitoring point input per switch.

3) Preaction Control Panels: Provide minimum of four monitoring point inputs per system.

6. Elevators:

a. Comply with ASME A17.1.

b. Elevator Shutoff:

1) Elevator Machine Room Heat Detector:

(a) Shut down elevator power prior to hoistway sprinkler activation.

(b) Locate within 24 inches of each sprinkler in accordance with NFPA 72.

2) Sprinkler Pressure or Waterflow: Shut down elevator power prior to hoistway sprinkler activation.

3) For each elevator, provide output signal to stop elevator via addressable relay module and power isolation relay.

c. Elevator Emergency Recall Operation:

1) Elevator Lobby, Hoistway, and Machine Room Smoke Detectors: Elevator recall for fire fighters' service.

2) In each elevator machine room, provide interface for each elevator car or group of elevator cars as determined by AHJ via separate addressable relay modules for each output signal below, where applicable.

(a) Recall elevator to designated (primary) level.

(b) Recall elevator to alternate level.

(c) Smoke detection in elevator machine room (fire fighter's hat light).

7. HVAC Systems:

a. Air Handling Units (AHUs) and Roof Top Units (RTUs):

1) Provide duct smoke detector on supply side of air stream for units over 2,000 cfm.

2) Provide duct smoke detector on return side of air stream for units over 15,000 cfm.

3) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.

4) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.

5) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.

b. Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.

2.2 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

A. Manufacturers:

1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
4. Edwards Systems Technology Inc.

5. Potter Electric Signal Company: www.pottersignal.com/#sle.
6. Approved Equal

B. Fire Alarm Control Units and Related Equipment: Listed and labeled as complying with UL 864.

C. Provide cabinets and enclosures as indicated or as required to house system components.

D. Fire Alarm Control Unit (FACU): Addressable.

1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
2. NACs: Integral and programmable with synchronization modules or cards as required.
3. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACU.
4. User-Interface: Touchscreen display for system interfacing and service mode settings, include password and user credentials; configurable for custom actions and incorporates historical event log.
5. Support self-testing detector capability.
6. Remote Annunciator Support: Up to 10.
7. Releasing Service: Required.
8. Enclosure Finish Color: Black.

E. Releasing Service:

1. Provide FACU listed for releasing service, UL 864.
2. Provide addressable releasing control modules as indicated or as required for control of solenoids listed for releasing applications.
3. Provide manual releasing stations for suppression system activation as indicated.
4. Provide alarm bells for audible notification as indicated. Interface to dedicated NAC or addressable control module, 24 VDC, supervised. Default operation march time pattern on activation of first event, continuous tone on release.
5. Provide strobes for visible notification as indicated. Interface to dedicated NAC or addressable control module, 24 VDC, supervised. Default operation flash on activation of first event, flash on release.
6. FACU capable of supporting 10 releasing zones for independent hazards, with each zone capable of three cross-zone and four abort options; provide adjustable delay and discharge timers.
7. Provide momentary red push button abort switches stainless steel wallplate and identify "SUPPRESSION SYSTEM ABORT."
8. Addressable Releasing Control Modules: See "Addressable Interface Modules" below.
9. Manual Release Station: See "Manual Pull Stations" under "Initiating Devices" article below.
10. Bells and Strobes: See "Notification Appliances" article below.

F. Addressable Interface Modules:

1. General Requirements:
    a. Provide addressable modules suitable for connection to FACU SLCs.
    b. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
2. Addressable Monitor Modules: Unless devices are explicitly permitted connected together on one zone; provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACU.
3. Addressable Control Modules: Provide as indicated or as required for selective control of notification appliances.
4. Addressable Releasing Control Modules: Provide as indicated or as required for control of listed solenoids in releasing applications.
5. Addressable Relay Modules:
    a. Provide as indicated or as required to perform necessary functions via dry-contact interface.
    b. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.

G. Alarm Communication:
1. Protected Premises Alarm and Signaling Systems:
    a. Provide accessories as required for interface as indicated and as required by AHJ.
    b. Provide accessories in accordance with building code, fire code, and life safety code requirements for occupancy classifications and use cases.
    c. Include software and firmware control, required features, special requirements for low-power radio (wireless) systems, and fire alarm system interconnections required by NFPA 72.
2. Supervising Station Alarm Systems:
    a. Provide accessories as required for interface with supervising station as indicated and as required by AHJ.
    b. Communication Method: Dual path, internet protocol (IP) primary with cellular backup.
    c. Supervise communication paths at interval required by NFPA 72.

H. Remote Annunciators:
1. LCD Remote Annunciators:
    a. Provide backlit LCD display that mimics FACU display.
    b. Provide dedicated status indications for power and alarm, supervisory, and trouble conditions.
    c. Enable system control functions including acknowledge, silence, and reset.
    d. Provide local audible alarm.
    e. Mounting: Wall-mounted; provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.

2.3 FIRE ALARM SYSTEM INITIATING DEVICES

A. Manufacturers:

1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
4. Edwards Systems Technology Inc.
5. Gentex Corporation.
6. System Sensor; a GE-Honeywell Company.
7. Approved Equal.
8. Source Limitations: Furnish initiating devices produced by same manufacturer as FACUs where possible.

B. General Requirements:

1. Addressable Systems:
    a. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs.
2. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
3. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.

C. Manual Fire Alarm Boxes/Pull Stations:

1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
3. Operation: Dual-action unless otherwise indicated or required.
    a. Dual-Action Operation: First requires pushing, pulling, or lifting, then pulling of lever.
4. Color: Red, in accordance with NFPA 72.
5. Station Reset: Requires use of key or tool.
    a. Photoelectric

D. Spot-Type Detectors:

1. Utilize plug-in mounting to separate base with tamper-resistant feature; provide bases as indicated or as required.

2. Addressable Detectors:
    a. Provide LED indication of normal operation and regular communication with FACU and alarm condition.
3. Smoke Detectors:
    a. Listed and labeled as complying with UL 268.
4. Thermal/Heat Detectors:
    a. Listed and labeled as complying with UL 521.
    b. Provide sensor type (e.g., fixed temperature, rate-of-rise) and rating as indicated.
5. Carbon Monoxide Detectors:
    a. Listed and labeled as complying with UL 2075.
    b. Provide end-of-life notification.

E. Duct Smoke Detectors:
1. Listed and labeled as complying with UL 268A.
2. Ratings: Compatible with air velocity, temperature, and humidity requirements for installed duct.
3. Housing: Select as required for application.
4. Sampling Tubes: Select as required for installation in duct to be monitored.

F. Accessories:
1. Remote Test Stations: Allows for detector key switch test and reset; provides visual and audible indication of alarm condition.

2.4 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. Manufacturers:
1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
4. Edwards Systems Technology Inc.
5. Gentex Corporation.
6. System Sensor; a GE-Honeywell Company.
7. Approved Equal.
8. Source Limitations: Furnish notification appliances produced by same manufacturer as FACUs where possible.

B. General Requirements:
1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.

2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Exterior Notification:
    a. In addition to required occupant notification, provide notification appliances on exterior of building.
    b. Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
    c. Sprinkler System Waterflow Visible Notification: Provide strobe beacon with clear lens; interface to dedicated NAC or addressable control module, 24 VDC, supervised; same circuit as sprinkler system waterflow audible notification where provided.
5. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.
    a. Where accessory protective guards or enclosures are utilized.
    b. Where required by field conditions (e.g., ambient temperature and sound).
6. Notification Appliance Color:
    a. Wall-Mounted: Red.
    b. Ceiling-Mounted: Red.
    c. See drawings for mounting configuration indicated by symbols on floor plans, system interconnection diagrams, and details.

C. Visible Notification Appliances:
1. Public Mode Operation: Listed and labeled as complying with UL 1971.
2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; LED light source with maximum pulse duration of 0.02 seconds; candela rating as indicated.
    a. Where field-selectable candela strobes are specified, substitution of fixed candela strobes is not permitted.

D. Audible Notification Appliances:
1. Listed and labeled as complying with UL 464.
2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet for public mode operation or 45 dBA at 10 feet for private mode operation in accordance with UL 464.
3. Horns: Selectable tone, including at minimum NFPA 72 temporal 3 pattern and continuous; minimum of two selectable volume levels.

E. Combination Notification Appliances: Comply with respective requirements for each signaling method.

2.5 WIRE AND CABLE

A. General Requirements:

1. Comply with NFPA 70 listing and marking requirements for cables.
2. Substitution of fire alarm listed cables for communication wiring, in accordance with NFPA 70, is not permitted.
3. Provide cables as indicated or as required for connections between system components.

B. Power-Limited Fire Alarm Cables (PLFA):

1. Comply with applications of listed cables in accordance with Chapter 7 of NFPA 70.
    a. Fire alarm cable substitutions in accordance with NFPA 70: Permitted.

C. Non-Power-Limited Fire Alarm Cables (NPLFA):

1. Comply with NPLFA circuit conductor properties in accordance with NFPA 72.
2. Comply with listing requirements in Chapter 7 of NFPA 70.

2.6 ACCESSORIES

A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.

B. Provide EoL resistors as required for wiring supervision.

C. Surge Protection:

1. Line Voltage Surge Protection:
    a. Provide for each line voltage circuit serving fire alarm system control units and related equipment (e.g., FACU, field booster panels, nodes, and transponders).
    b. Listed and labeled as complying with UL 1449.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.

B. Verify ratings, configurations, and characteristics of system components.

C. Verify rough-ins for field connections.

D. Verify that work likely to damage fire alarm system has been completed.

E. Verify that interior of building has been protected from weather.

F. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.

G. Verify that system bonding is in accordance with Section 26 0526.

H. Do not energize system until deficiencies have been corrected.

I. Verify that branch circuit wiring installation is completed, tested, and ready for connection to fire alarm system. Overcurrent protection ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

3.2 PREPARATION

A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer’s written instructions.

1. Clean and vacuum in accordance with manufacturer's written instructions. Confirm equipment ventilation holes are absent of obstructions and free for air flow.
2. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
3. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.
4. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.

C. Remove detector dust covers prior to system energization.

3.3 INSTALLATION

A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:

1. Manufacturer's instructions, applicable codes, and Contract Documents.
2. NECA 1.
3. NFPA 72.
4. NFPA 70; including requirements for mechanical execution of work.

B. Field Locations:

1. Obtain Owner's approval of locations of devices and notification appliances before installation.
2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.

C. Raceways and Supports:

1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.

3. Provide minimum of six spare 1-inch trade size conduits out of each fire alarm panel stubbed into accessible space above ceiling.
4. Install firestopping to preserve fire resistance rating of partitions and other elements.
5. Cable Trays: Coordinate non-power-limited fire alarm and other Class 1 circuits utilizing cable tray for support for maximum conductors in cable trays and raceways; including ampacity adjustment factors in accordance with NFPA 70.

D. Wiring and Connections:

1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
5. Provide grounding and bonding in accordance with Section 26 0526.
6. Comply with manufacturer's minimum cable sizes or ratings.
7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
8. Provide network wiring in accordance with NFPA 70.
9. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
10. See manufacturer's instructions for batteries.

E. Fire Alarm System Components:

1. Install field-installed devices, components, relays, notification appliances, accessories, and when applicable EoL resistors.
    a. Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections
2. Install Wall-Mounted Equipment: Assemble component hardware within (e.g., card bays, sub-bays, expansion bays, signal cards, other card frames, networking, signal transmission, application modules, tamper monitoring devices, interconnecting modules, and auxiliary power supplies), including space for required spare capacity, and configure settings.
3. Install Interconnect Wiring: Connect system cabinets, install processor and cards, cabling, connectors, terminations, and bonding.

F. Branch Power:

1. After installation confirmations, follow manufacturer instructions to connect branch circuit power cables to premises fire alarm system components; comply with NFPA 70.

2. Where accessories require auxiliary power, provide control power source and monitoring as indicated or as required to complete installation.
3. Install auxiliary power supplies, including indicated monitoring, and connections necessary for remote equipment.

G. System Identification:
1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 0553.
2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
3. Mark location of disconnecting means for NPFLA circuits.
4. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
5. Mark date of batteries installed on inside cover of panels and formal maintenance logs.

H. Troubleshooting and Installer Checks:
1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.
2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.

I. Fire Alarm System Tests:
1. Perform required tests of NFPA 72. Record measured values during operational checks.
2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.4 FIELD QUALITY CONTROL

A. Provide services of manufacturer's authorized representation to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.

B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

C. Inspect and test in accordance with manufacturer's instructions.

D. Inspect wiring and components for damage and defects.

E. Batteries and Power Supplies: Perform inspections and tests listed in manufacturer installation instructions.

F. Perform additional requirements related to testing and inspection during system startup.

G. Test for interface with other systems.

H. Test shunt trips to verify operation.

I. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

J. Submit detailed reports indicated inspection and testing results, corrective actions taken, and as-found and final adjusted settings.

3.5 SYSTEM STARTUP

A. Obtain Owner approval prior to performing system startup.

B. Manufacturer Services: Provide services of manufacturer's authorized representation to systems startup. Include manufacturer's detailed startup procedures with submittals.

C. Prepare and start equipment and systems in accordance with manufacturer's instructions and recommendations.

3.6 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust initiating device and notification appliance settings to achieve desired operation as indicated in submittals.

C. Measure power supply primary and secondary voltages, log values for records, and make appropriate adjustments.

D. Adjust alignment of equipment covers and doors. Provide keys and spare keys to Owner.

E. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.

F. Adjust devices or notification appliances and associated bases to be flush and level.

G. Program system parameters according to requirements of Owner.

3.7 CLEANING

A. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.

B. Clean and repair existing materials and equipment that remain or are indicated for reuse.

C. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.

D. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.

E. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.

F. Repair scratched or marred exposed surfaces to match original factory finish.

G. Comply with federal (EPA), state, and local regulations for battery handling and disposal. Do not spill battery fluids down plumbing drains. Only use containers safe for transportation marked 'nonspillable.'

3.8 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.

E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.

G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without system or equipment malfunctions.

1. Record system operations and malfunctions.

2. If malfunction occurs, start diagnostic period over after correction of malfunction.

3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.

4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.9 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:

1. Hands-On Instruction: On-site, using operational system.

B. Administrative: One-hour session(s) covering issues necessary for nontechnical administrative staff; classroom:

1. Initial Training: One session precloseout.

2. Refresher Training: One session post-occupancy.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:

1. Initial Training: One session precloseout.

2. Refresher Training: one session post-occupancy.

D. Use operation and maintenance documentation as primary instruction material; have paper copies available for attendees and supplement training material aids.

3.10 CLOSEOUT ACTIVITIES

A. Closeout Demonstration: Demonstrate operation of all functions to Owner.

1. Be prepared to conduct any of required tests.
2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
3. Have authorized technical representative of FACU manufacturer present during demonstration.
4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
5. Repeat demonstration until successful.

B. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:

1. Approved operating and maintenance data has been delivered.
2. All aspects of operation have been demonstrated to Owner.
3. Final acceptance of fire alarm system has been given by AHJ.
4. Specified precloseout instruction is complete.

C. Perform post-occupancy instruction within three months after Substantial Completion.

END OF SECTION

DIVISION

31

EARTHWORK

SECTION 31 0000

EARTHWORK

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. Preparing subgrades for [slabs-on-grade] [walks] [pavements] [turf and grasses] [and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete [walks] [pavements].
5. Subbase course[and base course] for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Section 01500 "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
2. Section 02230 "Site Clearing" for site stripping, grubbing, stripping[**and stockpiling**] topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Warning tapes.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

C. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Drainage Course: Narrowly graded mixture of [**washed**]crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

H. Sand: ASTM C 33; fine aggregate.

I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
6. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting[, low-density], flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, [3/4-inch (19-mm)] nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce low-density, controlled low-strength material with the following physical properties:

C. Produce conventional-weight, controlled low-strength material with [140-psi (965-kPa)] compressive strength when tested according to ASTM C 495.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

1. Perform blasting without damaging adjacent structures, property, or site improvements.
2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. [24 inches (600 mmoutside of concrete forms other than at footings.
b. [12 inches (300 mm)] outside of concrete forms at footings.
c. [6 inches (150 mm)] outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. [6 inches (150 mm)] beneath bottom of concrete slabs-on-grade.
f. [6 inches (150 mm)] beneath pipe in trenches, and the greater of [24 inches (600 mm)] wider than pipe or [42 inches (1065 mm)] wide.

3. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

4. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: [12 inches (300 mm) each side of pipe or conduit] [As indicated].

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below exterior slabs and pavements with a pneumatic-tired [and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes)] to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction[, repeating proof-rolling in direction perpendicular to first direction]. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions .

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Place and compact initial backfill of free of particles larger than [1 inch (25 mm)] in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.11 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction per geotechnical report.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than [8 inches (200 mm)] in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to [ASTM D 698].

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at [**95**] percent.
2. Under walkways, scarify and recompact top 8 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at [**95**] > percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at [**95**] percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at [**95**] percent.

3.14 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus [1 inch (25 mm)]
2. Walks: Plus or minus [1 inch (25 mm)] .
3. Pavements: Plus or minus [1/2 inch (13 mm)]

3.15 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course[and base course] on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course[and base course] under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade if necessary and according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course[and base course] to required crown elevations and cross-slope grades.
4. Place subbase course[and base course] 8 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase course[and base course] that exceeds 8 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 8 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact subbase course[and base course] at optimum moisture content to required grades, lines, cross sections, and thickness to not less than [95] percent of maximum dry unit weight according to [ASTM D 698].

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every [2000 sq. ft. (186 sq. m)] or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every [100 feet (30 m)] or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every [150 feet (46 mor less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 1000

SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 015000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
2. Section 017300 "Execution" for field engineering and surveying.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing conditions of adjoining properties, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by Architect.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
1. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Use only hand methods for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

A. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2000

EARTH MOVING

PART 4 - GENERAL

4.1 RELATED DOCUMENTS

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

4.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs on grade, curbs, walks, pavements, and landscaping
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete curbs, walks, and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Sections:

1. Section 013200 "Construction Progress Documentation", Section 013233 "Photographic Documentation" for recording preexcavation and earth moving progress.
2. Section 015000 "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Section 311000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
5. Section 334600 "Subdrainage" for drainage of foundations, slabs-on-grade, walls ,and landscaped areas.

4.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

4.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

4.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

4.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: One Call for area where Project is located before beginning earth moving operations.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 015000 "Temporary Facilities and Controls," Section 311000 "Site Clearing," are in place.

PART 5 - PRODUCTS

5.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

C. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Drainage Course: Narrowly graded mixture of **washed** crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

H. Sand: ASTM C 33; fine aggregate.

I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

5.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
6. Permittivity: 0.1 per second, minimum; ASTM D 4491.
7. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.

5.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, TYPE II.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, ¾" nominal maximum aggregate size.

5.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 6 - EXECUTION

6.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

6.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

6.3 EXPLOSIVES

A. Explosives: Do not use explosives.

6.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches outside of concrete forms other than at footings.
    b. 12 inches outside of concrete forms at footings.
    c. 6 inches outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches beneath bottom of concrete slabs-on-grade.
    f. 6 inches beneath pipe in trenches, and the greater 24 inches wider than pipe 42 inches wide.

6.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

6.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

6.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade for all slabs and pavement areas with a pneumatic-tired **and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes)**] to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction]. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

6.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

6.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

6.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

6.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated and shown in drawings. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Place and compact initial backfill of satisfactory material free of particles larger than **1 inch (25 mm)** in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

6.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

6.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction as indicated in the geotechnical report.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content and is too wet to compact to specified dry unit weight.

6.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 8 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 90 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

6.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

6.16 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
   1. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

6.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and sub base course under pavements and walks as follows:
   1. Place base course material over subbase course under hot-mix asphalt pavement.
   2. Shape subbase course and base course to required crown elevations and cross-slope grades.
   3. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
   4. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
   5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

6.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at locations and frequencies shown in the drawings and/or as indicated by the engineer.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

6.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

6.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2300

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.04 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses 2017.

B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2018.

C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)) 2012, with Editorial Revision (2015).

D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand- Cone Method 2015, with Editorial Revision (2016).

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)) 2012, with Editorial Revision (2015).

F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill - Subsoil excavated on-site.

1. Graded.
2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
3. Complying with ASTM D2487 Group Symbol CL.

B. Structural Fill:

1. Moisture content should be within 3% of optimum and compacted in maximum 8" lifts
2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey benchmarks and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Engineer.

3.03 TRENCHING

A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove excavated material that is unsuitable for re-use from site.

G. Remove excess excavated material from site.

H. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

I. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

F. Correct areas that are over-excavated.

1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

G. Compaction Density Unless Otherwise Specified or Indicated:

H. Reshape and re-compact fills subjected to vehicular traffic.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180 or ASTM D698 ("standard Proctor").

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

END OF SECTION

SECTION 31 3000

WATER DISTRIBUTION

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 water-distribution piping and related components outside the building for [combined water service and fire-service mains].

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1.4 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify the city of Rock Springs no fewer than [two] days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Engineers written permission.

1.6 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.2 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.

1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

C. PVC, AWWA Pipe: AWWA C900, as shown in drawings with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 FIBERGLASS PIPE AND FITTINGS

2.4 JOINING MATERIALS

A. Refer to Section 02080 "Piped Utilities - Basic Materials and Methods" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.5 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Metal-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.

1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 250 psig (1725 kPa).
3) End Connections: Push on or mechanical joint.
4) Interior Coating: Complying with AWWA C550.

4. OS&Y, Rising-Stem, Metal-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.

1) Standard: AWWA C500.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.7 CHECK VALVES

A. AWWA Check Valves:

1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.
b. Pressure Rating: 175 psig (1207 kPa).

2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.

a. Standards: UL 312 and FMG approved.
b. Pressure Rating: [175 psig (1207 kPa)] [250 psig (1725 kPa)].

2.8 WATER METERS

A. Water meters will be furnished by utility company.

B. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.

C. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.

D. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C706.

E. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

    a. Standard: AWWA C707.
    b. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
    c. Visible Display Units: Comply with utility company requirements for type and quantity.

2.9 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:
    1. See Civil Drawings.

B. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

    1. See Civil Drawings.

2.10 CONCRETE VAULTS

    a. See Civil Drawings.

B. Dry-Barrel Fire Hydrants:
    a. See Civil Drawings.

PART 3 - EXECUTION

3.1 EARTHWORK

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping shall be as shown in the civil drawing and/or the following: See Civil Drawings

    1. Ductile-iron,
    2. PVC Pipe

F. Underground Combined Water-Service and Fire-Service-Main Piping – See Civil Drawings.

1. Ductile-iron,
2. PVC,

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

B. Drawings indicate valve types to be used.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
1. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
2. Install corporation valves into service-saddle assemblies.
3. Install manifold for multiple taps in water main.
4. Install curb valve in water-service piping with head pointing up and with service box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

F. Sleeves are specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

G. Mechanical sleeve seals are specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

I. Make pipe joints according to the following:
1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Bolted flanged joints.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
4. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves

H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.7 DETECTOR-CHECK VALVE INSTALLATION

A. Install in vault or aboveground.

B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.8 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install [**displacement**] [**turbine**]-type water meters, NPS 2 (DN 50) and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install [**compound**] [**turbine**]-type water meters, NPS 3 (DN 80) and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.9 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.10 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.12 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA Fire Hydrants: Comply with AWWA M17.

D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.13 FLUSHING HYDRANT INSTALLATION

A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.

B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.

C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

3.14 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

3.15 IDENTIFICATION

A. Install continuous underground[**detectable**] warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 02300 "Earthwork."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 02080 "Piped Utilities - Basic Materials and Methods" for identifying devices.

3.16 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in

NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 31 4000

SANITARY SEWERAGE

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 and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.
6. Encasement for piping.
7. Manholes.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, [**T-1**] [**T-2**] wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Nonpressure-Type, Rigid Couplings:

   1. Manufacturers: Subject to compliance with requirements. See Civil Drawings.

D. PVC Cleanouts:

   1. Manufacturers: Subject to compliance with requirements, See Civil Drawings.

   2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.3 MANHOLES

A. Standard Precast Concrete Manholes:

   1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
   5. Riser Sections: 4-inch (100-mm) minimum thickness, of length to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
   9. Steps: See Civil Drawings.
   10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

   1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
   2. Material: See Civil Drawings.

2.4 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the civil drawings and the following:
1. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
2. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
3. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   2. Join dissimilar pipe materials with nonpressure-type, flexible[or rigid] couplings.

3.3 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Form continuous concrete channels and benches between inlets and outlet.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops [3 inches (76 mm)] above finished surface elsewhere unless otherwise indicated.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

   1. Use Light-Duty, top-loading classification cleanouts in [earth or unpaved foot-traffic] areas.
   2. Use Medium-Duty, top-loading classification cleanouts in [paved foot-traffic] areas.
   3. Use Heavy-Duty, top-loading classification cleanouts in [vehicle-traffic service] areas.
   4. Use Extra-Heavy-Duty, top-loading classification cleanouts in [roads].

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, [18 by 18 by 12 inches (450 by 450 by 300 mm)] deep. Set with tops [1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 15150 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-

inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 IDENTIFICATION

A. Comply with requirements in Section 02300 "Earthwork" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
    1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

    1. Submit separate report for each system inspection.
    2. Defects requiring correction include the following:

        a. Alignment: Less than full diameter of inside of pipe is visible between structures.
        b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
        c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
        d. Infiltration: Water leakage into piping.
        e. Exfiltration: Water leakage from or around piping.

    3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
    4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping.[Flush with potable water.]

END OF SECTION

SECTION 316329
DRILLED PIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Dry-installed drilled piers.

B. Slurry displacement-installed drilled piers.

C. Dry-installed or slurry displacement-installed drilled piers, at Contractor's choice.

1.03 RELATED SECTIONS

A. Section 012200 - Unit Prices: List of unit prices.

B. Section 015000 - Temporary Facilities and Controls.

C. Section 033000 - Cast-in-Place Concrete: General structural and building applications of concrete.

1.04 UNIT PRICES

A. Basis of Bids: Base bids on indicated number of drilled piers; design length from top elevation to bottom of shaft, extended through the bell, if applicable; and diameter of shaft and bell.

B. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and approved. Actual length, shaft diameter and, if applicable, bell diameter may vary to coincide with elevations where satisfactory bearing strata are encountered, and with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
   1. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, and other items for complete drilled-pier installation.
   2. See Division 1 Section "Unit Prices" for list of unit prices.

1.05 SUBMITTALS

A. See Section 013300 – Administrative Procedures for submittal requirements.

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

C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, and placing.

D. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Laboratory Test Reports: For evaluation of concrete materials and mix design.

E. Welding certificates.

F. Qualification Data: For Installer, land surveyor, and testing agency.

G. Record drawings at Project closeout according to Section 017700 - Closeout Submittals.

1.06 QUALITY ASSURANCE

A. Drilled-Pier Standard: Comply with provisions in ACI 336.1, "Reference Specifications for the Construction of Drilled Piers," unless modified in this Section.

B. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
   1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 to perform material evaluation tests and to design concrete mixes, as documented according to ASTM E 548.

D. Welding Standards: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

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

1.07 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
   1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is referenced elsewhere in the Project Manual for information only.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
   1. Steel Reinforcement: ASTM A 615, Grade 60, #3 Ties Grade 40, deformed.

2.02 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type IL.

B. Fly Ash: Type-F.

C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, 1-inch maximum aggregate size.

D. Water: Potable, complying with ASTM C 94/C 94M requirements.

E. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   3. High-Range, Water-Reducing Admixture: ASTM C 494, Type G.
   4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Sand-Cement Grout: Portland cement, ASTM C 150, Type II; clean, natural sand, ASTM C 404; and water to result in grout with a minimum 28-day compressive strength of 1000 psi, of consistency required for application.

2.03 STEEL CASINGS

A. Steel Pipe Casings: Smooth Steel Pipe for Temporary Casings to be withdrawn from excavations.

2.04 SLURRY

A. Slurry: Pulverized sodium bentonite, pulverized attapulgite, or polymers, mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH. Products must be American made.

2.05 CONCRETE MIX

A. Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases.
   1. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis.

B. Proportion mixes according to ACI 211.1 and ACI 301. See Specification Section 033000 for Concrete Specifications.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.02 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.
   1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.

D. Notify and allow Owner's testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
   1. Additional authorized excavation will be paid according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

F. Slurry Displacement Method: Stabilize excavation with slurry maintained a minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft. Maintain slurry properties before concreting.
   1. Excavate and complete concreting of drilled pier on same day, if possible, or redrill, clean, and test slurry in excavation before concreting.
   2. Clean bottom of each shaft before concreting.

G. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
   1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
   1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

I. Inspection: Each drilled pier must be inspected and tested by Owner's testing and inspecting agency before placing concrete.
   1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
   2. Notify Architect and testing agency at least six hours before excavations are ready for tests and inspections.

3.03 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.04 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
   1. Where concrete cannot be directed down shaft without striking reinforcing, place concrete with chutes, tremies, or pumps.
   2. Vibrate top 60 inches of concrete.

C. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than 60 inches into concrete, and flow of concrete is continuous from bottom to top of drilled pier.

D. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
   1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

E. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

F. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

G. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no greater than 90 deg F.
   1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled piers.

B. A drilled-pier report will be prepared by Owner's testing and inspecting agency for each drilled pier as follows:
   1. Actual top and bottom elevations.
   2. Top of rock elevation.
   3. Description of soil materials.
   4. Description, location, and dimensions of obstructions.
   5. Final top centerline location and deviations from requirements.
   6. Variation of shaft from plumb.
   7. Shaft excavating method.
   8. Levelness of bottom and adequacy of cleanout.
   9. Ground-water conditions and water-infiltration rate, depth, and pumping.
   10. Description, diameter, and top and bottom elevations of temporary or permanent casings.
   11. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
   12. Date and time of starting and completing excavation.
   13. Inspection report.
   14. Position of reinforcing steel.
   15. Concrete placing method, including elevation of consolidation and delays.
   16. Elevation of concrete during removal of casings.
   17. Locations of construction joints.
   18. Remarks, unusual conditions encountered, and deviations from requirements.
   19. Concrete testing results.

C. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by Owner's testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.

D. Concrete: Sampling and testing of concrete for quality control may include the following:

   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94/C 94M.
      a. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test, frequency of testing shall be per Specification Section 033000..

b. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
c. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens, unless field-cured test specimens are required.
d. Compressive-Strength Tests: ASTM C 39; frequency of testing shall be per Specification Section 033000. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and one specimen will be retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.
4. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
5. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
6. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.
7. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.
   a. Continuous coring of drilled piers may be required, at Contractor's expense, when temporary casings have not been withdrawn within specified time limits or where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

3.06 DISPOSAL OF MATERIALS

A. Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

END OF SECTION 316329

DIVISION

32

EXTERIOR IMPROVEMENTS

SECTION 32 1216

ASPHALT PAVING

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. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

B. Related Requirements:
1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:

C. Material Test Reports: For each paving material, by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with WYDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of WYDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel.

C. Fine Aggregate: **ASTM D 1073,** sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-22 grade, or approved by engineer.

B. Asphalt Cement: ASTM D 3381/D 3381M for viscosity-graded material

C. Tack Coat: ASTM D 977 emulsified asphalt.

2.3 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by engineer; designed according to procedures in AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: WYDOT Grading W Base
3. Surface Course: Contractor Furnished Mix Design

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to [ASTM D 6927] [or] [AASHTO T 245], but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

4. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T-168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION

SECTION 32 1313

CONCRETE PAVING

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. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Sections:

1. [Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"] for general building applications of concrete.
2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

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

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.

2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

1.5 QUALITY ASSURANCE

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

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

2. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

B. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of [40 deg F (4.4 deg C) for oil-based materials] [55 deg F (12.8 deg C) for water-based materials], and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

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

C. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

D. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

E. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

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

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

H. Zinc Repair Material: ASTM A 780.

2.2 CONCRETE MATERIALS

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

1. Portland Cement: ASTM C 150, portland cement (SEE GEOTECHNICAL REPORT)

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm)] nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

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

2.3 CURING MATERIALS

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

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

C. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.4 RELATED MATERIALS

A. Joint Fillers: [ASTM D 1751, asphalt-saturated cellulosic fiber] [or] [ASTM D 1752, cork or self-expanding cork] in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

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

D. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements.

2.5 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, colors complying with FS TT-P-1952.

B. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

C. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

D. Glass Beads: [AASHTO M 247, Type 1] [FS TT-B-1325, Type 1A].

2.6 WHEEL STOPS

A. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE, or commingled postconsumer and postindustrial recycled [rubber] [or] [plastic]; UV stabilized; [4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1820 mm) long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   1. Dowels: Galvanized steel, 3/4 inch (19 mm) in diameter, 10-inch (254-mm) minimum length.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

   1. Compressive Strength (28 Days): **4000 psi**.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: **0.50**
   3. Slump Limit**: See Geotechnical Report.**

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

   1. Air Content: **See Geotechnical Report**

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

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

   1. Use [water-reducing admixture] [high-range, water-reducing admixture] [high-range, water-reducing and retarding admixture] [plasticizing and retarding admixture] in concrete as required for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M[and ASTM C 1116/C 1116M]. Furnish batch certificates for each batch discharged and used in the Work.

   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of [1/2 inch (13 mm)] <Insert dimension> according to requirements in Section 312000 "Earth Moving."

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
1. .
2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows**,** to match jointing of existing adjacent concrete.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a [1/4-inch (6-mm)] [3/8-inch (10-mm)] radius. Repeat grooving of contraction joints after applying surface finishes.[Eliminate grooving-tool marks on concrete surfaces.]

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

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

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a [1/4-inch (6-mm)] [3/8-inch (10-mm)] radius. Repeat tooling of edges after applying surface finishes.[Eliminate edging-tool marks on concrete surfaces.]

3.5 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

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

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

L. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray formsand subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound as follows:
1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.8 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

3.10 WHEEL STOPS

A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.

B. Securely attach wheel stops to paving with not less than two [**galvanized-**]steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

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

1. Testing Frequency: Obtain at least one composite sample for each [100 cu. yd. (76 cu. m)] [5000 sq. ft. (465 sq. m)] or fraction thereof of each concrete mixture placed each day.

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

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

F. Concrete paving will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 1373

CONCRETE PAVING JOINT SEALANTS

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. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Joint-sealant application, joint location, and designation.
3. Joint-sealant manufacturer and product name.
4. Joint-sealant formulation.
5. Joint-sealant color.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1.4 FIELD CONDITIONS

A. 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 deg F (5 deg C)].
2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturers for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.

C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I.

B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.

C. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required 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 joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.

2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within concrete paving

1. Joint Location:

a. Expansion and isolation joints in concrete paving.
b. Contraction joints in concrete paving.
c. Other joints as indicated.

B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving

1. Joint Location:

a. Joints between concrete and asphalt paving.
b. Joints between concrete curbs and asphalt paving.
c. Other joints as indicated.

END OF SECTION

SECTION 321500
AGGREGATE SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Crushed stone surfacing.

1.02 RELATED REQUIREMENTS

A. Section 321120 - Subbase and Aggregate Base Courses.

1.03 REFERENCE STANDARDS

A. ASTM C131/C131M - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine; 2020.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Samples: Two full-sized sections of surface reinforcement units, or minimum 1 foot (300 mm) square piece of roll reinforcement, whichever is applicable.

PART 2 PRODUCTS

2.01 MATERIALS

A. Crushed Stone Surfacing: Pit run, washed, 3/8 inch (1 cm) stone; free of shale, clay, friable material, and debris.

B. Aggregate Base Course: See Section 321120.

C. 5 oz non-woven geotextile separation fabric.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subgrade has been prepared correctly, is smooth, and is at proper grade and level.

B. Do not begin work until subgrade is correct.

3.02 INSTALLATION

A. Place aggregate base course, see Section 321123.

B. Place surfacing or aggregate-turf pavement in maximum 4 inch (100 mm) layers.
   1. Roller compact to specified density.

3.03 CLEANING

A. Remove unused or stockpiled fill, base, and reinforcement.

B. Clean adjacent surfaces of excess sand, gravel, soil, and debris. Sweep broom clean.

3.04 PROTECTION

A. Protect turf from traffic other than emergency vehicles for minimum of 8 weeks, or until the root system has penetrated and established grass well below the turf reinforcement units.

END OF SECTION

SECTION 32 1713

PARKING BUMPERS

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 wheel stops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Resilient Wheel Stops: Solid, integrally colored, 96 percent postconsumer or commingled postconsumer and preconsumer recycled [rubber] [or] [plastic]; UV stabilized; [4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1800 mm) long] <Insert dimensions>. Provide chamfered corners with factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Mounting Hardware: Galvanized-steel [spike or dowel, 1/2-inch (13-mm) diameter, 10-inch (254-mm) minimum length] [lag screw, shield, and washers; 1/2-inch (13-mm) diameter, 8-inch (203-mm) minimum length] [hardware as standard with wheel-stop manufacturer].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

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

3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

SECTION 321726
TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast iron tactile warning surfacing.

1.02 RELATED REQUIREMENTS

A. Section 321623 - Sidewalks.

B. Section 321723 - Pavement Markings.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

C. ATBCB PROWAG - Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, standard details, details specific to this project, written installation, and maintenance instructions.

C. Executed warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.

B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F (4 and 32 degrees C).

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide standard 10-year warranty against manufacturing defects, breakage, or deformation of cast iron tiles. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cast Iron Tactile Warning Surfacing:
   1. Neenah Foundry, a division of Neenah Enterprises, Inc: www.nfco.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Cast Iron Tactile Warning Surfacing:
   1. Material: Gray cast iron; ASTM A48/A48M, Class 30 A, minimum.
   2. Shape: Rectangular.
   3. Pattern: Truncated cones complying with ADA Standards.
   4. Joint: Manufacturer standard, built-in, quick connectors.
   5. Finish: Unfinished.

2.03 ACCESSORIES

A. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions.
   1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
   2. Do not install when ambient or substrate temperature has been below 40 degrees F (4 degrees C) during the preceding 8 daylight hours.

B. Field Adjustment:
   1. Locate relative to curb line in accordance with ATBCB PROWAG, Sections 304 and 305.
   2. Orient so dome pattern is aligned with the direction of ramp.

C. Install units fully seated to substrate, square to straight edges and flat to required slope.

D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

E. Cast in Place:
   1. When installing multiple adjacent units, leave 3/16-inch (5 mm) gap between units to allow for expansion.
   2. Tamp and vibrate units as recommended by manufacturer.
   3. Place and position weights on units while concrete cures.
   4. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Inspect for raised edges and misalignment.

C. Nonconforming Work: Remove and replace.

3.03 CLEANING

A. Remove protective plastic sheeting within 24 hours of installation.

B. Remove excess sealant or adhesive from joints and edges.

C. Clean four days prior to date of scheduled inspection.

3.04 PROTECTION

A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.

B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 323223
SEGMENTAL RETAINING WALL

PART 1 GENERAL

1.01 SUMMARY

A. The work covered by this section includes the furnishing of all labor, materials, equipment, inspection and construction of a modular concrete Segmental Retaining Wall ("SRW") including drainage system and geosynthetic reinforcement. The work included in this section consists of, but is not limited, to the following:
   1. Excavation and foundation soil preparation.
   2. Furnish and placement of the Leveling Base.
   3. Furnish and placement of the Drainage system.
   4. Furnish and placement of Geotextile Fabric.
   5. Furnish and placement of SRW units.
   6. Furnish and placement of Geosynthetic Reinforcement.
   7. Furnish, placement, and compaction of Backfill and Drainage Aggregates
   8. Furnish final grading.

1.02 REFERENCES

A. Project Geotechnical Report

B. ASTM International, latest edition:
   1. Segmental Retaining Wall Units
      a. C 33, Standard Specification for Concrete Aggregates
      b. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
      c. C979, Standard Specification for Pigments for Integrally Colored Concrete.
      d. C1372, Standard Specification for Dry-Cast Segmental Retaining Wall Units
   2. Aggregate Materials
      a. C33, Standard Specification for Concrete Aggregates
      b. D448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction
      c. D2940, Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
   3. Geotextile Fabric
      a. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity
      b. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile
   4. Soils
      a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
      b. D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   5. Drainage Pipe
      a. D3034, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
      b. F667, Standard Specification for Large Diameter Corrugated Polyethylene (PE) Pipe and Fittings

1.03 SUBMITTALS

A. Segmental Retaining Wall:
   1. Samples for verification: Three representative full-size samples of SRW. Thickness, color and finish that indicate the range of color variation and texture expected upon project completion.
   2. Accepted samples become the standard of acceptance for the product produced.
   3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C1372.

4. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

B. Adhesive and Sealant:
   1. Provide manufacturer's technical data sheets indication the physical properties and performance.
   2. Test results from an independent testing laboratory indicating the product strength.

C. Geotextile Fabric
   1. Provide product data sheets.
   2. Provide three representative samples 6in by 6in.

D. Geosynthetic Reinforcement (Geogrid):
   1. Provide product data sheets.
   2. Provide three representative samples 8in by 12in.

E. Structural Engineer Design:
   1. Provide signed and sealed (stamped) drawings include all detailed design calculations for UWS's over 30 inches from a licensed structural engineer as required by local building codes.
   2. Structural design of walls shall accommodate all wall design conditions on site. Refer to details for related concrete design. If modifications to concrete design is required that design shall be included in the design submittal for the wall.

F. Wall Installation Contractor:
   1. Job references from a minimum of three projects similar in size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.
   2. Furnish sealed construction documents with detailed structural design calculations.

1.04 QUALITY ASSURANCE

A. Utilize a Manufacturer having at least ten years of experience manufacturing concrete SRW on projects of similar nature or project size.

B. Source Limitations:
   1. Obtain SRW from one source location with the resources to provide products of consistent quality in appearance and physical properties.
   2. Obtain Drainage Aggregate and Backfill Aggregate from one source.
   3. Obtain only natural Base and Subbase Aggregates quarried from an approved supplier. Recycled Crushed Concrete Base and Crushed Concrete Subbase Aggregates are not acceptable.

C. SRW Contractor Qualifications:
   1. Utilize an installer having successfully completed SRW installation similar in design, material, and extent indicated on this project.

D. Mockups:
   1. Install a 5 linear foot x 2 foot tall SRW.
   2. Use this area to determine installation tolerances. This area will serve as the standard by which the workmanship will be judged.
   3. Subject to acceptance by owner, mock-up may be retained as part of finished work.
   4. 4.If mock-up is not retained, remove and dispose legally.

1.05 DELIVERY, STORAGE & HANDLING

A. In accordance with Conditions of the Contract and Division 1 Product Requirement Section.

B. Deliver SRW in manufacturer's original, unopened and undamaged container packaging with identification labels intact.
   1. Coordinate delivery and SRW schedule to minimize interference with other construction activities.
   2. Unload SRW at job site in such a manner that no damage occurs to the product or adjacent surfaces.

3. Store materials in accordance with manufacturer's recommendations and in a manner to prevent damage.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:
   1. Install Leveling Base Aggregates only over unfrozen and dry subgrade soils.
   2. Install Universal Base Units only when temperature is above 32 degrees Fahrenheit.
   3. Install SRW on Universal Base Units only over unfrozen and dry subgrade soils.

B. Weather Limitations:
   1. Install only when no heavy rain or snowfalls are forecast within 24 hours.

1.07 SRW OVERAGE AND ATTIC STOCK

A. A. Provide a minimum of 5% additional material for overage to be used during construction.

B. Contractor to provide 50 face feet of each product and size used to owner for maintenance and repair. Furnish SRW from the same production run as installed materials.

C. Manufacture to supply maintenance and reinstatement manuals for SRW units.

PART 2 PRODUCTS

2.01 SEGMENTAL RETAINING WALL ("SRW") AND COPING

A. Basis-of-Design Product: SRW modular, solid, dry-cast concrete blocks based on:
   1. Unilock:
      a. SIENA EDGE™
   2. As manufactured by:
      a. Unilock, 301 E. Sullivan Rd., Aurora, IL 60505
   3. The specified products establish minimum requirements that substitutions must meet to be considered acceptable.
      a. To obtain acceptance of unspecified products, submit written requests at least 7 days before the Bid Date.
   4. Substitutions: No substitutions permitted.

B. Product requirements:
   1. SRW Type 1: Classic
      a. Color: to be selected from manufacturer's full range.
      b. Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.
         1) STANDARD: 35 1/2 x 11 1/2 x 7" (900 x 290 x 180mm) - Note: Imperial dimensions are nominal equivalents to the metric dimensions.
      c. Plastic Insert Tubes or Spacers: Furnished with Product line, if required.
      d. LEED: HPD 2.1 or latest transparency data.
   2. SRW Type2: Classic
      a. Color: FIELDSTONE
      b. Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.
         1) COPING: 35 1/2 x 11 1/2 x 7" (900 x 290 x 180mm) - Note: Imperial dimensions are nominal equivalents to the metric dimensions.
      c. Plastic Insert Tubes or Spacers: Furnished with Product line, if required.

C. Provide SRW meeting the requirements set forth in ASTM C1372.

D. Provide SRW meeting the physical properties listed below as tested using ASTM C140:
   1. Dimensional tolerance shall be +/- 3 mm (1/8 in.) for height, width, and length.
   2. The minimum 28-day compressive strength of 35 MPa (5000 psi).
   3. The maximum moisture absorption shall be 1.0 kN/cubic m (6.5 lbs/cubic ft).

E. Provide SRW utilizing an integral shear key connection with offset to create:
   1. Battered wall

2. Near vertical wall

F. Accept only pigments in concrete pavers conforming to ASTM C 979.
Note: ACI Report No. 212.3R provides guidance on the use of pigments.

2.02 LEVELING BASE AGGREGATE

A. Provide non-frost susceptible, well-graded, compacted angular gravel-sand mixture (GW as per ((ASTM D2487))) Leveling Base conforming to ASTM D 2940 and gradation requirements as presented in Table 1.

TABLE 1
LEVELING BASE AGGREGATE GRADATION REQUIREMENTS

ASTM D 2940	
Sieve Size	**Percent Passing**
2 in	100
1-1/2 in	95 to 100
3/4 in	70 to 92
3/8 in	50 to 70
No. 4	35 to 55
No. 30	12 to 25
No. 200	0 to 8*
*In order to prevent damage by frost heaving, it may be necessary to limit the percentages of material passing the No. 200 sieve to less than shown in the tables.	

2.03 BACKFILL AGGREGATE

A. Provide Base Aggregate materials conforming to ASTM D 2940 and gradation requirements as presented in Table 2.

TABLE 2
BACKFILL AGGREGATE GRADATION REQUIREMENTS

ASTM D 2940	
Sieve Size	**Percent Passing**
2 in	100
1-1/2 in	95 to 100
3/4 in	70 to 92
3/8 in	50 to 70
No. 4	35 to 55
No. 30	12 to 25
No. 200	0 to 8*
*In order to prevent damage by frost heaving, it may be necessary to limit the percentages of material passing the No. 200 sieve to less than shown in the tables.	

2.04 DRAINAGE AGGREGATE FILL

A. Provide Drainage Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as presented in Table 3.

TABLE 3
DRAINAGE AGGREGATE GRADATION REQUIREMENTS

ASTM No. 8	
Sieve Size	**Percent Passing**
1/2 in	100
3/8 in	85 to 100
No. 4	10 to 30

TABLE 3 DRAINAGE AGGREGATE GRADATION REQUIREMENTS	
No. 8	0 to 10
No. 16	0 to 5

2.05 UNDERDRAINAGE PIPE

A. Provide a minimum 100 mm (4 inches) Underdrainage Pipe using:
   1. Perforated corrugated high density polyethylene (HDPE) meeting ASTM F667.
   2. Perforated polyvinyl chloride (PVC) pipe meeting ASTM D3034.

B. Protect with Geotextile Fabric to prevent the migration of soil particles into the Underdrainage Pipe.

2.06 GEOTEXTILE FABRIC

A. Provide Geotextile material conforming to the following performance characteristics, measured per the test methods referenced:
   1. 4 oz., nonwoven needle punched geotextile composed of 100% polypropylene staple fibers that are inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.
   2. Grab Tensile Strength: ASTM D 4632: 115 lbs.
   3. Grab Tensile Elongation: ASTM D 4632: 50%
   4. Trapezoidal Tear: ASTM D4533: 50 lbs.
   5. Puncture: ASTM D4833: 65 lbs.
   6. Apparent Opening Size: ASTM D 4751: 0.212 mm, 70 U.S. Sieve
   7. Permittivity: ASTM D 4491: 2.0 sec -1
   8. Flow Rate: ASTM D 4491: 140 gal/min/s.f.

B. Geotextile Fabric meeting these requirements include:
   1. Carthage Mills – FX-40HS
   2. U.S. Fabrics
   3. Mirafi
   4. Gator Fabric

2.07 GEOSYNTHETIC REINFORCEMENT

A. Provide Geosynthetic Reinforcement as supplied by Unilock (301 E. Sullivan Rd., Aurora, IL 60505).
   1. Stratagrid SGU 60
   2. Stratagrid SGU 100
   3. Gator Grid 30-30
   4. Gator Grid 50-50

2.08 CONCRETE ADHESIVE

A. Provide a Concrete Adhesive manufactured by the following:
   1. LePage:
      a. Product Type: PL Premium Polyurethane construction adhesive.
      b. LePage PL 9000 Heavy Duty construction adhesive.
   2. Alliance:
      a. Product Type: Gator Glue XP Polyurethane construction adhesive
   3. Unilock Concrete Adhesive
   4. PolyBind XP Polyurethane Adhesive

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas indicated to receive SRW for compliance with requirements for installation tolerances and other conditions affecting performance for the following items:

1. Verify that subgrade preparation, compacted density and elevations conform to minimum specified requirements.
2. Verify all site services are located outside of SRW construction area unless otherwise noted.
3. Verify that the Base Aggregate material, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
4. Verify the Leveling Base Aggregate horizontal alignment conforms to the SRW alignment.
5. Provide written density test results for soil subgrade, Base Aggregate materials to the Owner, General Contractor and SRW installation subcontractor.
6. Verify that the subgrade soil is free from standing water.
7. Verify the SRW structure or excavation limits are within property boundaries and do not cross into adjacent properties unless approved prior to construction.
8. Verify the SRW drainage system delivers outflow to approved location.
9. Verify the SRW and associated excavation remains outside of the loading influence of other adjacent structures and ensure stability of excavations and conformance with applicable regulations.

B. Geotechnical Inspection.
1. Verify soil parameters and groundwater conditions are acceptable for SRW.
2. Verify subgrade Bearing Capacity meets or exceeds values required for area to receive SRW.
3. Identify groundwater conditions and/or other water source prior to SRW installation. Note additional water sources such as seepage from the cut embankment.
4. Ensure that surface water runoff and/or other sources of water are being controlled during construction and directed away from the SRW to a functioning drain.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Beginning of Universal Base Units signifies acceptance of the subgrade soil elevations.

3.02 CONSTRUCTION TOLERANCES

A. A. Installation of SRW facia shall be within all the following acceptable tolerances:
1. Vertical Control: +/- 1.25 inches over a 10 ft distance
2. Horizontal Control: Straight lines: +/- 1.25 inches over a 10 ft distance
3. Rotation of the SRW face: Maximum 2.0 degrees from established SRW plan batter or +/- 10.0% from total established horizontal setback
4. Bulging: +/- 1.25 inch over a 10 ft distance

3.03 CONSTRUCTION

A. SITE PREPARATION
1. Comply with all current Federal, Provincial/State, and local regulations for execution of the work, including local building codes and excavation regulations. Provide excavation support as required to maintain stability of the area during excavation and SRW construction and to protect existing structures, utilities, landscape features, property, or improvements.
2. Prior to grading or excavation of the site, confirm the location of the SRW and all underground features, including utility locations within the area of construction. Ensure surrounding structures are protected from effects of SRW excavation.
3. Coordinate installation of underground utilities with SRW installation.
4. Control surface water drainage and prevent inundation of the SRW construction area during the construction process.
5. Excavate the foundation soil to the required grades. Trim the subgrade to within 0 to ½ in. (0 to 13mm) of the specified grades. Do not deviate the surface of the prepared subgrade by more than 3/8 in. (10mm) from the bottom edge of a 39 in. (1m) straight edge laid in any direction.
6. Excavated the native soils to the lines and grades indicated in cut situations. Document and remove from the site.

7. Prevent excavated soils being reused onsite from contamination or overly saturate the stockpiled fill material.
8. Prevent damage to underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.
9. Compact soil subgrade uniformly to at least 95 percent of Standard Proctor Density per ASTM D698. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils.
10. Do not proceed with further SRW construction, under any circumstances, until the subgrade has been inspected.

    Note: Base compaction of the subgrade soil on the recommendations of the Design Engineer. Inspect subgrade preparations, elevations and conduct density tests for conformance to specifications.

B. GEOTEXTILE FABRIC
1. Provide separation geotextile on bottom and sides of prepared soil subgrade. Secure in place to prevent wrinkling or folding from equipment tires and tracks.
2. Overlap ends and edges a minimum of 18 in. (450 mm) in the direction of drainage.

C. LEVELING BASE AGGREGATE
1. Spread Leveling Base aggregate in areas indicated for SRW in accordance with horizontal and vertical alignments.
2. Compact the Leveling Base Aggregate material with at least two passes per lift using a vibratory plate compactor applying a minimum of 4,000lbs.(18kN) over compacted subgrade soil material. Compact to at least 98 percent Standard Proctor Density as per ASTM D698.
3. Tolerance: Do not exceed the specified surface grade of the compacted Base Aggregate material more than ±3/8 in. (10 mm) over a 10 ft. (3 m) long straightedge laid in any direction.

D. CAST-IN-PLACE LEVELING SLAB
1. Install concrete leveling base per approved structural submittals.
2. Level units in all directions. Do not pitch.

E. INSTALLATION OF ISEGMENTAL RETAINING WALL UNITS
1. Place the SRW bottom row in the middle of the Leveling Base. Ensure the SRW Units are aligned properly, leveled from side to side and front to back, and in complete contact with the Leveling Base.
2. Interconnect the SRW shear key creating the specified batter of the SRW face.
3. Sweep the SRW top clean before placing additional courses to ensure that no dirt, concrete, or other foreign materials become lodged between successive lifts.
    a. Place Geosynthetic Reinforcement as required.
4. Offset SRW units to create a running bond pattern with the edge of all units being approximately aligned with the middle of the unit in the course below it. Place cut SRW half units to ensure the vertical line between adjacent SRW units remains within the middle third of the SRW unit below.
5. Provide Drainage and Backfill Aggregate once three courses above grade have been placed. Backfill with additional aggregates after a maximum of three courses of SRW units have been placed above the previous Backfill and Drainage Aggregate level.
6. Verify no gaps are formed between successive lists affection performance and correct before proceeding with additional lists.
7. Ensure SRW Units and Geosynthetic Reinforcement are not damaged during handling and placement.
8. Prevent heavy equipment, for compaction, fill placement or other, within 1 meter (3 ft.) from back of the SRW Units.

F. DRAINAGE SYSTEM
1. Place the Geotextile Fabric against the back of the first SRW Unit, over the prepared foundation soil extending towards the back of the excavation, up the excavation face and

eventually over the top of the Drainage Fill to the back of the SRW Units near the top of the wall. Overlap Geotextile minimum of 300 mm (1 ft.) and shingle down the face of the excavation in order to prevent the migration.

2. Provide Underdrainage Pipe in accordance with the overall drainage plan for the site. Slope Underdrainage Pipe to ensure gravity flow of water from the Backfill Aggregate. Connect Underdrainage Pipe at a storm sewer catch basin or daylight along slope at an elevation lower than lowest point of pipe within Backfill Aggregate mass, every 15 m (50 feet) maximum.
3. Install chimney or blanket drains if other sources of water are discovered during excavation or anticipated.
4. Fill and cover the Underdrainage pipe and trench with Drainage Aggregate and Geotextile fabric.

G. DRAINAGE FILL
1. Provide Drainage Fill between the back of wall and Backfill Aggregate.
2. Place a minimum width of 300 mm (1 ft.) and separated from other soils using the specified Geotextile Fabric.
3. Place Drainage Fill behind the SRW facing in maximum lifts of 150 mm (6 inches) and compacted to a minimum density of 95% Standard Proctor.

H. BACKFILL AGGREGATE
1. Provide Backfill Aggregate behind SRW and Drainage Fill with a maximum lift thickness of 150 mm (6 inches) and compacted to a minimum density of 95% Standard Proctor Maximum Dry Density (((ASTM D698))) at a moisture content from 2% below to 2% above optimum.
2. Slope the last lift of Backfill Aggregate away from the SRW facing to rapidly direct runoff away from the SRW at the end of each day's operation. Prevent surface runoff from adjacent areas to enter the SRW construction area.

I. GEOSYNTHETIC REINFORCEMENT (for SRW walls over 30 inches tall)
1. Verify type and primary strength direction of the Geosynthetic Reinforcement.
2. Sweep the top of the SRW Units to ensure the SRW Units are clean and free of debris.
3. Cut Geosynthetic Reinforcement in sheets to the length shown in the Construction Documents.
4. Place Geosynthetic Reinforcement sheets horizontally with the primary strength direction perpendicular to the SRW face and adjacent sheets without overlapping and without gaps between them.
5. Ensure each Geosynthetic Reinforcement layer corresponds with the correct elevations and Drainage Fill is level to prevent voids.
6. Place the Geosynthetic Reinforcement over the compacted Backfill Aggregate and the SRW Units with the outside edge extending over the shear key of the SRW Unit to within 25 mm (1 in.) of the front facing unit.
7. Carefully place subsequent SRW Units on top of the lower course to ensure that no pieces of concrete are chipped off and become lodged between courses. Ensure the Geosynthetic Reinforcement is in complete contact with the top and bottom surfaces of the successive SRW courses.
8. Pull Geosynthetic Reinforcement taut away from SRW Units during Backfill Aggregate placement. Provide Geosynthetic Reinforcement anchoring pins or staples to ensure that there are no wrinkles or slackness prior to Backfill Aggregate placement. Ensure Geosynthetic Reinforcement lays flat when pulled back perpendicular to the back of the SRW.
9. Prevent construction equipment from operating directly on top of the Geosynthetic Reinforcement until a minimum thickness of 150 mm (6 inches) of Reinforcement Fill has been placed.
10. Prevent heavy equipment from within 1 meter (3. Ft.) of the back of the SRW Units.

J. RETAINED FILL

1. Provide compacted Retained Fill behind the Backfill Aggregate or Drainage Fill in maximum lift thickness of 150 mm (6 inches).

K. SECURE COPING
   1. Sweep the last SRW course clean of all debris.
   2. Secure SRW Coping to SRW Units with two 10 mm (3/8 inch) beads of Concrete Adhesive positioned 50mm (2 inches) in front and behind the groove of the last course of SRW Units.

L. FINISHING SRW
   1. Finish grading above SRW to direct surface runoff water away. Grade a swale above the SRW sloping away from back of the wall. Establish final grading immediately to ensure and protect the Backfill Aggregate from water infiltration.
   2. Prevent additional structures (fences, handrails, vehicular guardrails, buildings, pools/ponds, etc.) or changes to grading/loading (increased height, slopes, parking areas, changes in proximity to water flow, etc.), other than those shown in the Construction Documents, from being installed.
   3. Prevent landscaping activities within the Reinforcement Fill to ensure:
      a. The Geosynthetic Reinforcement is not damaged by excavation for the root ball
      b. The SRW is not subjected to any additional load from plants or trees.

3.04 REPAIRING AND CLEANING

A. Remove and replace SRW Coping Units that are chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. BCleaning: Remove excess dirt, debris, stains, grit, etc. from exposed SRW Units; wash and scrub clean.
   1. Clean SRW Units in accordance with the manufacturer’s written recommendations.

3.05 PROTECTION

A. Protect completed work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 323300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Benches.

B. Bollards.

C. Waste receptacles.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Bollard infill and underground encasement.

B. Section 055000 - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.

C. Shop Drawings: Indicate plans for each unit or group of units, elevations with model number, overall dimensions, construction, and anchorage details.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer’s warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.

C. Provide manufacturer’s Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trash Receptacle: See plans.
   1. Include plastic liner and tether.
   2. Mounting: Surface, using concealed anchor rods.
   3. Provide one extra plastic liner

B. Circular Bench: See plans.

C. Wood Benches: See plans.

2.02 PICNIC TABLES

A. Outpost Wood Table Frame Kit
   1. https://www.barcoproducts.com/galvanized-steel-frame-only-for-outpost-table or approved equal
   2. Includes easy-to-assemble galvanized tube frame and stainless-steel assembly hardware. Provide any required hardware not included in manufacturer's kit.
   3. Use rectangular table frame to make 6 ft tables.
   4. Rugged, 2-3/8" OD, 12-gauge galvanized steel frames.

B. Contractor shall provide lumber and construct:
   1. Provide cedar lumber to mount on frame to match fence lumber
   2. Use same treatment as fence.

C. Product includes 10-year limited guarantee on galvanized frame

D. Provide double ADA galvanized frame for 1 in 4 tables

2.03 WOOD BENCHES

A. Materials:
   1. Wood: Solid, A -Grade Teak.
   2. Factory Finish: Natural.

B. Benches: Solid wood supports and seat section with back.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.

B. See Section 055000 for anchors to attach site furnishings to mounting surfaces.

C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

B. See Section 033000 for bollard infill and underground encasement.

C. Provide level mounting surfaces for site furnishing items.

END OF SECTION

SECTION 323313
SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

A. See Section 013000 - 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. 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. Maglin; 2900 Series - MUG; https://www.maglin.com/product/mug-bike-rack/ Bike Rack; .
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 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: In-ground grout cover.

B. Materials:

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

C. Surface Mount per manufacturer's complete instructions.

D. Post-Installed Anchors: Comply with ICC-ES AC308.

E. Freestanding Installation: Place in location indicated on drawings.

3.03 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.04 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

SECTION 328423
UNDERGROUND SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings, valves, sprinkler heads, emitters, bubblers, and accessories.

B. Control system.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 312316.13 - Trenching: Excavating and backfilling for irrigation piping.

1.03 REFERENCE STANDARDS

A. ASTM B32 - Standard Specification for Solder Metal; 2020.

B. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

C. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

D. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.

E. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.

F. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).

G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with site backfilling, landscape grading and delivery of plant life.

B. Preinstallation Meeting: Convene one week prior to commencing work of this Section.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component and control system and wiring diagrams.

C. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used.

D. Operation and Maintenance Data:
   1. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
   2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.

E. Record Documents: Record actual locations of all concealed components piping system.

F. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Sprinkler Heads: One of each type and size.
   3. Extra Valve Keys for Manual Valves: Two.
   4. Extra Valve Box Keys: Two.
   5. Wrenches: One for each type head core and for removing and installing each type head.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 10 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable code for piping and component requirements.

2.02 IRRIGATION SYSTEM

A. Electric solenoid controlled underground irrigation system, with pressure blow-out drain.
   1. Source Power: 120 volt, ____ A., ____ phase.

B. Manufacturers:
   1. Rain Bird Sales, Inc; ____: www.rainbird.com/#sle.
   2. Toro Company; ____: www.toro.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.03 PIPE MATERIALS

A. PVC Pipe: ASTM D2241; 200 psi (1.38 MPa) pressure rated upstream from controls, 160 psi (1.10 MPa) downstream; solvent welded sockets.

B. Fittings: Type and style of connection to match pipe.

C. Pipe Risers at Valves: 160 psi (1.10 MPa) PVC pipe.

D. Pipe Risers at Valves: 100 psi (0.69 MPa) ABS pipe.

E. Pipe Risers at Valves: 200 psi (1.4 MPa) copper pipe.

F. Solvent Cement: ASTM D2564 for PVC pipe and fittings.

G. Solder and Flux: ASTM B32 solder, with suitable flux.

H. Sleeve Material: PVC.

2.04 OUTLETS

A. As indicated on the plans.

2.05 VALVES

A. As indicated on the plans.

2.06 CONTROLS

A. As indicated on the plans.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify location of existing utilities.

B. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.

B. Layout and stake locations of system components.

C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

A. Trench to accommodate grade changes and slope to drains.

B. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.04 INSTALLATION

A. Connect to utilities.

B. Set outlets and box covers at finish grade elevations.

C. Provide for thermal movement of components in system.

D. Use threaded nipples for risers to each outlet.

E. Install control wiring in accordance with Section 260519. Provide 10 inch (250 mm) expansion coil at each valve to which controls are connected, and at 100 ft (30 m) intervals. Bury conduit beside pipe.

F. Mark valves with neoprene valve markers containing locking device. Set valve markers in pipe risers extending from top of valve to finish grade.

G. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 014000 - Quality Requirements.

B. Prior to backfilling, test system for leakage at main piping to maintain 100 psi (690 kPa) pressure for one hour.

C. System is acceptable if no leakage or loss of pressure occurs and system self drains during test period.

3.06 BACKFILLING

A. Provide 3 inch (75 mm) sand cover over piping.

B. Backfill trench and compact to specified subgrade elevation. Protect piping from displacement.

3.07 SYSTEM STARTUP

A. Prepare and start system in accordance with manufacturer's instructions.

B. Adjust control system to achieve time cycles required.

C. Adjust head types for full water coverage as directed.

3.08 CLOSEOUT ACTIVITIES

A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.09 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide one complete spring start-up and a fall shutdown by installer, at no extra cost to Owner.

END OF SECTION

SECTION 329119
LANDSCAPE GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Topsoil placement.

B. Finish grading.

1.02 RELATED REQUIREMENTS

A. Section 311000 - Site Clearing.

B. Section 312323 - Fill.

C. Section 329219 - Seeding.

D. Section 329223 - Sodding.

1.03 REFERENCE STANDARDS

A. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

B. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

1.04 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

B. Field Quality Control Submittals: Topsoil depth measurements.

1.05 FIELD CONDITIONS

A. Place topsoil during dry weather.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil A: Comply with ASTM D5268.

B. Topsoil B: Topsoil excavated on-site.
   1. Free of roots, rocks larger than 1 inch, subsoil, debris, large weeds and foreign matter.
   2. Acidity Range (pH): 5.5 to 7.5.
   3. Comply with ASTM D2487 Group Symbol OH.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify grading and intended elevations are as indicated on drawings.

B. Verify absence of standing or ponding water.

3.02 PREPARATION

A. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size.

B. Scarify surface to depth of 3 inches (75 mm).

3.03 TOPSOIL PLACEMENT

A. Uniformly distribute and spread topsoil.

B. Place topsoil to the following compacted thicknesses:
   1. Areas Indicated Seeded with Grass: 6 inches (150 mm).
   2. Areas Indicated as Sodded: 6 inches (150 mm).
   3. Shrub Beds: 18 inches (450 mm) See detail for additional requirements.

3.04 FINISH GRADING

A. Maintain profiles and contour of subgrade.

B. Remove roots, weeds, rocks, and foreign material while spreading.

C. Maintain uniform topsoil thickness.

D. Lightly compact placed topsoil.

E. Maintain stability of topsoil during inclement weather. Replace eroded topsoil.

F. Apply seed, see Section 329219.

G. Apply sod; see Section 329223.

3.05 TOLERANCES

A. Topsoil Thickness: 1/2 inch (13 mm) plus/minus.

3.06 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove unused topsoil. Grade stockpile area to prevent standing water.

3.07 PROTECTION

A. Protect from stormwater runoff and subsequent construction operations.

B. Do not permit traffic until established.

END OF SECTION

SECTION 329219
SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Seeding, mulching and fertilizer.

D. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading.

B. Section 321500 - Aggregate Surfacing.

C. Section 329119 - Landscape Grading.

D. Section 329300 - Plants.

1.03 REFERENCE STANDARDS

A. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

B. ASTM D7322/D7322M - Standard Test Method for Determination of Erosion Control Product (ECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions; 2017.

1.04 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass. Others as indicated by Wyoming regulatory agencies.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Certificate: Certify seed mixture approval by authority having jurisdiction.

C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in original sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5percent weed seed:

C. Grass-Seed Mix: Proprietary seed mix as follows:

1. Products: Subject to compliance with requirements, provide the following seed mixes, or approved equal. See plans for seeding locations.

D. Seed Mixtures:
   1. Sagebrush/Desert Mix (Red Desert or Wyoming Basins):
      a. This mix include foundational native shrubs crucial for wildlife habitat (like Greater Sage-Grouse) and specific desert conditions.

	Species (Common Name)	(Lbs PLS/Acre)
1)	Wyoming Big Sagebrush	0.25 lbs/ac (low rate due to tiny seed size)
2)	Indian Ricegrass	0.75 lbs/ac
3)	Western Wheatgrass	2.00 lbs/ac
4)	Basin Wildrye	1.00 lbs/ac
5)	Needle-and-Thread	0.15 lbs/ac
6)	Rocky Mountain Beeplant	0.25 lbs/ac (forb)

   2. Reclamation Mix:
      a. Buffalo Brand Shortgrass Mix.
         1) *Drought tolerant, sod-forming, warm season grasses for the short grass prairie.*
            (a) 50% BLUE GRAMA, NATIVE
            (b) 25% BUFFALOGRASS, SHARP'S IMPROVED II W/ KNO3
            (c) 25% SIDEOATS GRAMA, NATIVE
         2) Seeding Rate
            (a) 15 LBS per acre (drill seed)
            (b) 25 LBS per acre (broadcast seed)
      b. Nurse crop:
         1) *Mix into Shortgrass Mix as a nurse crop*
            (a) 100% Annual Ryegrass (Lolium perenne ssp. Multiflorum)
         2) Seeding Rate
            (a) 25 LBS per acre (drill seed)
            (b) 35 LBS per acre (broadcast seed)

2.02 ACCESSORIES

A. Mulches:
   1. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
   2. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

B. Fertilizer: Recommended for grass, with 50 percent of the elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil, to the following proportions:
   1. 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
   2. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Erosion-Control Materials:
   1. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, [6] inches long.

D. Pesticides:
   1. 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.

2. 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.
3. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 312200-Grading.

B. Place topsoil in accordance with Section 329119-Landscape Grading.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.03 PREPARATION FOR EROSION-CONTROL MATERIALS:

A. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

B. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 SEEDED TURFGRASS

A. Two-Step Drill Seeding
   1. Uniformly distribute seed with a turfgrass drill seeder such as Brillion, with 2” or less row spacing. Drill seed to ¼” depth from two directions with at least 45 degree difference in angle of approach. After seeding all areas shall be cultipacked with a pull-behind cultipacker until a minimum of 85% of the seed is covered or otherwise accepted by the Architect.
      a. Do not use wet seed or seed that is moldy or otherwise damaged.
      b. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at rates per seed type specifications

C. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions, per plans.

D. Fertilizing: Immediately after completion of planting, fertilize all turf planting areas with specified maintenance fertilizer at rates specified to be applied through the fertigation system until end of specified Landscape grow-in Period.

3.06 HYDROMULCHING

A. Mix slurry with fiber-mulch manufacturer's recommended tackifier.

B. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre

3.07 DRILL SEEDING

A. Submit method

3.08 BROADCAST SEEDING

A. Apply seed at a rates indicated above evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Do not sow immediately following rain, when ground is too dry, or during windy periods.

D. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches (3 mm). Maintain clear of shrubs and trees.

E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.

F. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches (100 by 100 mm).

3.09 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean surrounding areas of construction debris.

3.10 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation. Contractor is responsible for maintaining turf as specified until landscape/site substantial completion at which time the Owner will assume maintenance responsibilities.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
   4. Grow-In Period
      a. Contractor is responsible for maintaining turf during grow in period until substantial completion when owner assumes maintenance responsibility as follows:
         1) Provide turf with 2.17 lbs/1,000 sq. ft. per month of nitrogen and mow a minimum of 3 times per week through the grow-in period of 90 days.
         2) Maintenance fertilizer shall be UFLEX granular fertilizer
         3) Keep turf areas free of weeds at all times.

B. Irrigation
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of [1] inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow lawn areas to a height of [2] inches.

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

E. Maintain turf in manner required to produce healthy turf, uniform in color and leaf texture, and free from weeds and other undesirable growth.
   1. Grass Density - Lawns: 20 plants per sq ft (200 plants per sq m), minimum.
   2. Bare Spots - Lawns: 2 percent of total area, maximum; 6 inches (150 mm) square, maximum.
   3. Keep turf relatively free of thatch, woody plant roots, diseases, nematodes, soil-borne insects, stones larger than 1 inch (25 mm) in diameter, and other materials detrimental to grass growth.
   4. Limit broadleaf weeds and patches of foreign grass to maximum of 2 percent of total area.

F. Mowing: During growing season, mow turf to uniform height, preventing scalping, rutting, bruising, and uneven or rough cutting.
   1. Prior to mowing, clean debris and leaves from turf surface.
   2. Schedule frequency of mowing so no more than one-quarter to one-third of grass leaf length is removed during cutting.
   3. Make each successive mowing at approximately 45 degrees to previous mowing, if practical.
   4. Cool Season Grasses:
      a. Reduce mowing height in fall and spring.
      b. Use rotary-type mowers; mulcher-type mowers may be used.
   5. Warm Season Grasses:
      a. Increase mowing height slightly as fall approaches.
      b. Use reel-type mowers; do not use mulcher mowers.
   6. Remove grass clippings.

G. Summer Mowing Height for Lawns:
   1. Bluegrass: 3 inches (75 mm).

H. Reseeding: Comply with requirements of this section.

I. Cleanup:
   1. Clean adjacent pavements of plant debris and other debris generated by maintenance activities.
   2. Remove and dispose of general cleanup debris and biodegradable debris; Owner's trash collection facilities may be used.
   3. Remove and dispose of general cleanup debris and biodegradable debris.
      a. Biodegradable Debris: Deposit biodegradable debris in Owner's designated on-site compost pile, branches and bark are not considered biodegradable.
      b. Branches and Bark: Machine-chip branch and bark debris; deposit resulting debris in Owner's designated wood chip storage area.
      c. Non-Biodegradable Debris: Owner's trash collection facilities may be used.

3.11 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Seeded Turf: At end of warranty period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by [5] inches

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of 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. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.14 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
   1. Seeded Turf: until landscape/site substantial completion.
      a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

B. Weed Control:
   1. Contractor shall maintain weed control during the grow-in period or until substantial completion. All herbicides shall be approved before applying to ensure that they don’t retard germination or establishment of the turf. In some cases, this could mean hand removal of weeds at critical times during the germination or establishment periods.

END OF SECTION

SECTION 329223
SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Fertilizing.

C. Sod installation.

D. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading.

B. Section 329119 - Landscape Grading.

C. Section 329300 - Plants.

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Certificate: Certify grass species and location of sod source.

C. Certificate: Certify fertilizer and herbicide mixture approval by authority having jurisdiction.

D. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.06 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum ten (10) years experience, and certified by the State of Wyoming.
   1. Acceptable Sod Producers and Suppliers
      a. Torrington Sod Farms, 7244 Road 51, Torrington, WY 82240, www.torringtonsodfarms.com
      b. Turfmaster Sod, LLC, 324 Ayers Road, Wheatland, WY 82201, www.turfmastersod.com
      c. Rocky Mountain Sod, 11100 N 95th E, Idaho Falls, ID 83401, (208) 522-5955, www.rockymountainsod.com
      d. Or otherwise approved prior to five days before Bid Date.

B. Installer Qualifications: Company specializing in sod installation with a minimum of three (3) years verified experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration. Keep roots moist by placing in shade and applying a fine mist watering until ready for placement.

B. Do not deliver more sod than can be laid within 24 hours.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft (100 sq m). Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
   1. Kentucky Blue Grass Type: 100 percent.
   2. Thickness: "Thick" sod, minimum 1 inch (25 mm) and maximum 1-3/8 inch (35 mm) topsoil base.
   3. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

C. Fertilizer: Commercial high phosphorus starter fertilizer; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:

D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

E. Regulatory Requirements:
   1. Comply with regulatory agencies for fertilizer and herbicide composition.
   2. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

2.02 ACCESSORIES

A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

B. Herbicide: As recommended by the turfgrass sod supplier for the species mixture specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 312200.

B. Place topsoil in accordance with Section 329119.

3.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 24 hours after harvesting to prevent deterioration. Sod with dried out roots prior to installation will be rejected.

C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches (300 mm) minimum. Do not stretch or overlap sod pieces.

D. Water sodded areas immediately after installation. Saturate sod to 4 inches (100 mm) of soil.

E. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean surrounding areas of construction debris.

3.06 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Protect sodded areas with warning signs during maintenance period.

C. Maintain turf to produce healthy turf, uniform in color and leaf texture, and free from weeds and other undesirable growth until Final Acceptance of the project by the Owner.
   1. Grass Density - Lawns: 20 plants per sq ft (200 plants per sq m), minimum.
   2. Bare Spots - Lawns: 2 percent of total area, maximum; 6 inches (150 mm) square, maximum.
   3. Keep turf relatively free of thatch, woody plant roots, diseases, nematodes, soilborne insects, stones larger than 1 inch (25 mm) in diameter, and other materials detrimental to grass growth.
   4. Limit broadleaf weeds and patches of foreign grass to maximum of 2 percent of total area.

D. Mowing: During growing season, mow turf to uniform height, preventing scalping, rutting, bruising, and uneven or rough cutting.
   1. Prior to mowing, clean debris and leaves from turf surface.
   2. Schedule frequency of mowing so no more than one-quarter to one-third of grass leaf length is removed during cutting.
   3. Make each successive mowing at approximately 45 degrees to previous mowing, if practical.
   4. Cool Season Grasses:
      a. Reduce mowing height in fall and spring.
      b. Use rotary-type mowers; mulcher-type mowers may be used.
   5. Warm Season Grasses:
      a. Increase mowing height slightly as fall approaches.
      b. Use reel-type mowers; do not use mulcher mowers.

E. Summer Mowing Height for Lawns:
   1. Bluegrass: 3 inches (75 mm).
   2. Fescue, Creeping Red: 3 inches (75 mm).
   3. Fescue, Fine: 2 inches (50 mm).
   4. Fescue, Tall: 4 inches (100 mm).

F. Trimming: Immediately after each mowing, neatly trim perimeter of each turf area and around obstructions within turf area; match height and appearance of adjacent turf.
   1. Adjacent to Pavements: Cut edges of turf to form distinct, uniform turf edge.
   2. Adjacent to Planting Beds and Permanently Mulched Areas: Cut edges of turf to form distinct, uniform turf edge.
   3. Around Other Trees and Poles: Where no planting bed or mulched area exists, trimming with string trimmer is acceptable.
   4. At Fences: Trim on both sides of fence.
   5. Irrigation Heads and Valve Boxes: Trim neatly so grass does not interfere with operation.

G. Resodding: Comply with requirements of this section.

H. Cleanup:
   1. Clean adjacent pavements of plant debris and other debris generated by maintenance activities.

2. Remove and dispose of general cleanup debris and biodegradable debris; Owner's trash collection facilities may be used.
3. Remove and dispose of general cleanup debris and biodegradable debris.
   a. Biodegradable Debris: Deposit biodegradable debris in Owner's designated on-site compost pile; branches and bark are not considered biodegradable.
   b. Branches and Bark: Machine-chip branch and bark debris; deposit resulting debris in Owner's designated wood chip storage area.
   c. Non-Biodegradable Debris: Owner's trash collection facilities may be used.

END OF SECTION

SECTION 329300
PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plants

B. Mulch and Fertilizer.

C. Maintenance.

D. Tree Pruning.

1.02 RELATED REQUIREMENTS

A. Section 329119 - Landscape Grading: Topsoil placement and finish grading.

1.03 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Weeds: Any plant life not specified or scheduled.

C. Plants: Living trees, plants, and ground cover specified in this Section , and described in ANSI Z60.1.

1.04 REFERENCE STANDARDS

A. ANSI/AHIA Z60.2 - American Standard for Nursery Stock; 2025.

B. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.

1.05 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.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Certificate: Certify fertilizer and herbicide mixture approval by authority having jurisdiction.

C. Certificate: Submit certificate for plants free of disease or hazardous insects; certified by federal department of agriculture; free of disease or hazardous insects.

D. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   3. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. 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.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.09 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. Contractors are advised that optimal weather conditions tend to be in the spring and early summer and fall months, depending on specific climatic conditions of the particular year.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide one year warranty.

C. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.

D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

1.11 MAINTENANCE (SEE END OF SECTION)

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

2.02 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

B. 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.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

C. 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.

D. 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.

E. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

2.03 SOIL MATERIALS

A. Topsoil: Type B; see Section 329119.
1. If Type B material runs out, use Type A – imported topsoil.

2.04 SOIL AMENDMENT MATERIALS

A. Fertilizer: Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
1. Nitrogen: Submit percent.
2. Phosphoric Acid: Submit percent.
3. Soluble Potash: Submit percent.

B. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

2.05 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Roots Healthy Start 12-8-8- Macro Tablets or approved equal
2. Size: 7-gram or 21-gram tablets per manufacturer’s recommended for plant size and type.
3. Nutrient Composition: 12 percent nitrogen, 8 percent phosphorous, and 8 percent potassium, by weight plus micronutrients.

2.06 MULCH MATERIALS

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Ground or shredded Cedar bark

B. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
1. Type: Design intent is to match the color and type of stone of the existing ground. This is shown in the reference photo on sheet L400
2. Type: Use a 50/50 blend of Wyoming Pink and Granite Rock as locally sourced as possible. Reference
3. Size Range: Use two sizes
   a. 75% less than 1’ in size
   b. 25% less than 2” in size

C. Large Mineral Mulch: Hard, durable stone, free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
1. Type: On site harvested stones.

a. Additional imported stones of a character that matches the on-site material is acceptable, however, a minimum of 25% of the total stone shall be from on-site sourced material

2. Size Range: between 4” and 18” in size, generally flat, larger stones may be placed within the creek bed as a feature.
   a. More rounded shapes are acceptable for a limited portion (25% or so) of the stones.
3. Placement: Place stones per details.

2.07 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.~~ NO WEED BARRIER UNDER MINERAL MULCH ON THIS SITE.

2.08 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.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.09 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: Softwood lumber pointed end. Not Metal. No Tee Stakes.

C. Cable, Wire, Eye Bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches.

E. Tree Trunk Protectors: 24" or 32" tall UV stabilized White Corrugated tree protectors with stakes and ties.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
   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. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
   3. Suspend planting 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 or which is dusty.

B. 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.

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

3.02 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.

3.03 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329119-Landscape Grading.

B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade, Place modified planting soil over exposed subgrade or Blend planting soil in place per drawings.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. 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.
   2. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown, and fabric bag-grown stock.
   3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   5. 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.
   6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   7. Maintain supervision of excavations during working hours.
   8. Keep excavations covered or otherwise protectedwhen unattended by Installer's personnel.
   9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

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.

3.05 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of 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. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare above adjacent finish grades 1 inch above in gravelly soils and 2 inches above in clay soils.
   1. Backfill: Excavated soil mixed with topsoil for backfill.
   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. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
      a. Quantity: per manufacturer’s recommended
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare above adjacent finish grades 1 inch above in gravelly soils and 2 inches above in clay soils
   1. Backfill: Excavated soil mixed with topsoil for backfill.
   2. Carefully remove root ball from container without damaging root ball or plant.
   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. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
      a. Quantity: per manufacturer’s recommended
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare 2 inches above adjacent finish grade.
   1. Backfill: Excavated soil mixed with topsoil for backfill.
   2. Spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
   3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
   4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
      a. Quantity: per manufacturer’s recommended
   6. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 PLANTING

A. Set plants vertical.

B. Remove non-biodegradable root containers.

C. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches (of 150 mm) under each plant. Remove burlap, ropes, and wires, from the root ball.

D. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch (150 mm) layers. Maintain plant life in vertical position.

E. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.07 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.

3.08 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
   1. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

B. Tree Trunk protectors shall be installed so bottom is in contact with dirt around trunk.

3.09 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

C. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.

D. Mineral Mulch in Planting Areas: Apply 3-inch average thickness of mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.10 INSTALLATION OF SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.11 TREE PRUNING

A. Prune trees as recommended in ANSI A300 Part 1.

B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.12 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

B. Irrigate sufficiently to saturate root system and prevent soil from drying out.

C. Remove dead or broken branches and treat pruned areas or other wounds.

D. Neatly trim plants where necessary.

E. Immediately remove clippings after trimming.

F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

G. Control insect damage and disease. Apply pesticides in accordance with manufacturers instructions.

H. Remedy damage from use of herbicides and pesticides.

I. Replace mulch when deteriorated.

J. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.

3.13 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.
   1. Contractor shall be responsible for filling slow-release watering devices until final completion when owner assumes maintenance responsibility.

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 when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.14 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to 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 Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.15 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
   1. Submit details of proposed pruning and repairs.
   2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
   3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

3.16 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. 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.

D. 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.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.17 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: until substantial completion of the site at which time the Owner will assume maintenance responsibilities.
2. Site Substantial Completion will be determined separately from building Substantial Completion but carries the same contractual implications as the primary Substantial Completion.

END OF SECTION

DIVISION

33

SITE UTILITIES

SECTION 33 4100

STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

3.1 RELATED DOCUMENTS

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

3.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Drains.
8. Encasement for piping.
9. Manholes.
10. Channel drainage systems.
11. Catch basins.
12. Stormwater inlets.
13. Stormwater detention structures.
14. Pipe outlets.

3.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. [Catch basins] [stormwater inlets] Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

3.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle [catch basins] [and] [stormwater inlets] according to manufacturer's written rigging instructions.

PART 4 - PRODUCTS

4.1 SEE CIVIL DRAWINGS

4.2 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

4.3 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

A. Push-on-Joint Piping:

1. Pipe: AWWA C151, for push-on joints.
2. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
3. Compact Fittings: AWWA C153, for push-on joints.
4. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

B. Mechanical-Joint Piping:

1. Pipe: AWWA C151, with bolt holes in bell.
2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
3. Compact Fittings: AWWA C153, with bolt holes in bells.
4. Glands: Cast or ductile iron, with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

4.4 STEEL PIPE AND FITTINGS

A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.

1. Special-Joint Bands: Corrugated steel with O-ring seals.
2. Standard-Joint Bands: Corrugated steel.
3. Coating: [Aluminum] [Zinc].

4.5 ALUMINUM PIPE AND FITTINGS

A. Corrugated Aluminum Pipe and Fittings: ASTM B 745/B 745M, Type I with fittings of similar form and construction as pipe.

1. Special-Joint Bands: Corrugated steel with O-ring seals.
2. Standard-Joint Bands: Corrugated steel.

4.6 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.

1. NPS 3 to NPS 6 (DN 80 to DN 150): SDR 35.
2. NPS 8 to NPS 12 (DN 200 to DN 300): SDR 42.

B. Gaskets: ASTM F 477, elastomeric seals.

4.7 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

4.8 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Piping:

1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, [SDR 35] PVC socket-type fittings.

B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, [**SDR 35**] PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679 PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, PVC pipe with bell ends
3. Gaskets: ASTM F 477, elastomeric seals.

G. PVC Water-Service Piping:

1. Pipe: ASTM D 1785 PVC, with plain ends for solvent-cemented joints.Fittings: PVC, socket type.Laminating Resin
2. Reinforcement: Grade with finish compatible with resin.

4.9 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Ring-Type, Flexible Couplings:

D. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include [**150-psig (1035-kPa)**] minimum pressure rating and ends sized to fit adjoining pipes.

E. Center-Sleeve Material: Manufacturer's standard

F. Gasket Material: Natural or synthetic rubber.

4.10 BACKWATER VALVES

A. Plastic Backwater Valves:

4.11 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Top-Loading Classification(s): [Light Duty] [Medium Duty] [Heavy Duty] [and] [Extra-Heavy Duty].
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

4.12 DRAINS

A. Cast-Iron Area Drains:

B. Cast-Iron Trench Drains:

1. Description: Factory fabricated from ASTM A 242/A 242M, welded steel plate, to form rectangular body with uniform bottom downward slope of 2 percent toward outlet, anchor flange, and grate. Include units of total length indicated, bottom outlet of size indicated, outlet strainer, acid-resistant enamel coating on inside and outside surfaces, and grate with openings of total free area at least two times cross-sectional area of outlet.

4.13 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
11. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
12. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.
13. frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
14. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

4.14 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

2. Covers: Solid gray iron if indicated.
3. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

4. Large Catch Basins:

    a. 24-by-12-inch (610-by-305-mm) polymer-concrete body, with outlets in quantities and sizes indicated.
    b. Gray-iron slotted grate.
    c. Frame: Include gray-iron or steel frame for grate.

5. Small Catch Basins:

    a. 19- to 24-inch by approximately 6-inch (483- to 610-mm by approximately 150-mm) polymer-concrete body, with outlets in quantities and sizes indicated.
    b. Gray-iron slotted grate.
    c. Frame: Include gray-iron or steel frame for grate.

4.15 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

4.16 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening[, of materials and dimensions according to utility standards].

B. Gutter Inlets: Made with horizontal gutter opening[, of materials and dimensions according to utility standards]. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings[, of materials and dimensions according to utility standards]. Include heavy-duty frames and grates.

4.17 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

PART 5 - EXECUTION

5.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

5.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

5.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
7. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
8. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
9. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
10. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
11. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
12. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
13. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
14. Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.
15. Join nonreinforced-concrete sewer piping according to ASTM C 14 (ASTM C 14M) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
16. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
17. Join dissimilar pipe materials with nonpressure-type flexible couplings.

B. Join force-main pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.
5. Join dissimilar pipe materials with pressure-type couplings.

5.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

5.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in [earth or unpaved foot-traffic] areas.
2. Use Medium-Duty, top-loading classification cleanouts in [paved foot-traffic] areas.
3. Use Heavy-Duty, top-loading classification cleanouts in [vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in [roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, [18 by 18 by 12 inches (450 by 450 by 300 mm)] deep. Set with tops [1 inch (25 mm)] above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

5.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in [earth or unpaved foot-traffic] areas.
2. Use Medium-Duty, top-loading classification drains in [paved foot-traffic] areas.
3. Use Heavy-Duty, top-loading classification drains in [vehicle-traffic service] areas.
4. Use Extra-Heavy-Duty, top-loading classification drains in [roads].

B. Embed drains in 4-inch (102-mm) minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in [4-inch (102-mm)] minimum concrete around bottom and sides.

5.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

5.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

5.9 STORMWATER INLET[**AND OUTLET**] INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

5.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

5.11 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in [4-inch (102-mm)] minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

5.12 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Section 221413 "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    a. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

5.13 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>.

    a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

5.14 CLEANING

A. Clean interior of piping of dirt and superfluous materials [Flush with water.]

END OF SECTION

SECTION 33 4600

SUBDRAINAGE

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. Perforated-wall pipe and fittings.
2. Drainage conduits.
3. Drainage panels.
4. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Drainage conduits, including rated capacities.
2. Drainage panels, including rated capacities.
3. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 (DN 150) and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 (DN 200) and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

2.2 DRAINAGE CONDUITS

A. Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cuspated, molded-plastic drainage core wrapped in geotextile filter fabric.

2.3 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earth Moving."

2.4 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO [M 288 Class 2.
2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (150 mm) deep and 12 inches (300 mm) wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

F. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of **flat-style geotextile filter fabric** over top of drainage course, overlapping edges at least 4 inches (100 mm).

J. Install drainage panels on foundation walls as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
3. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.
4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches (100 mm).

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.

E. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

G. Place drainage course in layers not exceeding 3 inches (75 mm) in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of [flat-style geotextile filter fabric] over top of drainage course, overlapping edges at least 4 inches (100 mm).

I. Install drainage panels on wall as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing as described elsewhere in this Specification. Do not install aggregate.
3. If weep holes are used instead of drainage pipe, cut 1/2-inch- (13-mm-) diameter holes on core side at weep-hole locations. Do not cut fabric.
4. Mark horizontal calk line on wall at a point 6 inches (150 mm) less than panel width above footing bottom. Before marking wall, subtract footing width.
5. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.

J. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.5 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping level and with a minimum cover of [**36 inches (915 mm)**] <**Insert dimension**> unless otherwise indicated.
2. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of [**36 inches (915 mm)**] <**Insert dimension**> unless otherwise indicated.
3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping according to ASTM D 2321.

3.6 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.7 BACKWATER VALVE INSTALLATION

A. Comply with requirements for backwater valves specified in Section 334100 "Storm Utility Drainage Piping."

B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.

C. Install horizontal backwater valves in piping where indicated.

3.8 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for [Foundation] [Retaining-Wall] Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, [18 by 18 by 12 inches (450 by 450 by 300 mm)] deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 (DN 100) [cast-iron] [PVC] pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, [12 by 12 by 4 inches (300 by 300 by 100 mm)] deep. Set top of cleanout [1 inch (25 mm)] [2 inches (50 mm)] above grade.
4. Comply with requirements for concrete specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]

3.9 CONNECTIONS

A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

3.11 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

APPENDIX

SUBSURFACE EXPLORATION

AND GEOTECHNICAL

ENGINEERING REPORT

Ms. Moriah L. Teuscher
Trona Valley Community
Federal Credit Union
840 Hitching Post Dr.
Green River, WY 82935

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING REPORT

TRONA VALLEY
FEDERAL CREDIT UNION NEW HEADQUARTERS
SWEETWATER COUNTY, WY

INBERG-MILLER ENGINEERS
193 W. Flaming Gorge Way
Green River, WY 82935
(307) 875-4394
www.inberg-miller.com

24624-GX

DATE ISSUED: MAY 14, 2025

INBERG-MILLER ENGINEERS

www.inberg-miller.com

May 14, 2025

24624-GX

PDF REPORT EMAILED: MTEUSCHER@TRONAVALLEY.COM
THIS CONSTITUTES THE ORIGINAL

Ms. Moriah L. Teuscher
Trona Valley Community Federal Credit Union
840 Hitching Post Dr.
Green River, WY 82935

RE: SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING REPORT
TRONA VALLEY FEDERAL CREDIT UNION NEW HEADQUARTERS
SWEETWATER COUNTY, WY

Dear Ms. Teuscher:

This letter transmits our Subsurface Exploration and Geotechnical Engineering report for the above-referenced project. The work described in this report has been completed in accordance with our Service Agreement dated February 4, 2025.

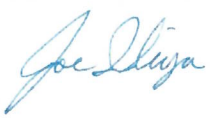
It has been a pleasure participating in this project. Additional services we could provide include:

- environmental assessment
- civil engineering
- plan and specification review
- surveying
- construction materials testing
- observation of excavations and earthwork

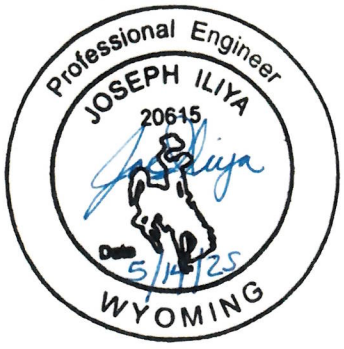
If you have any questions or comments, please contact our Green River office at (307) 875-4394.

Sincerely,

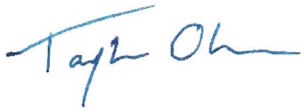
INBERG-MILLER ENGINEERS



Joe Iliya, P.E.
Geotechnical Engineer
jiliya@inberg-miller.com



REVIEWED BY:



Taylor Olson, P.E.
Geotechnical Engineer
tolson@inberg-miller.com

JEI:TKO:ajg\\P:\24624-GX TRONA VALLEY FCU Headquarters Final Geotech Report\Geotech\24624-GX Report.docx

Table of Contents

1.0 INTRODUCTION 1
1.1 EXECUTIVE SUMMARY 1
1.2 PURPOSE AND SCOPE OF SERVICE 1
2.0 CONDITIONS 2
2.1 SITE DESCRIPTION 2
2.2 PROJECT CONDITIONS 2
2.3 SOIL/ROCK CONDITIONS 3
2.4 GROUNDWATER CONDITIONS 3
3.0 RECOMMENDATIONS 4
3.1 SITE PREPARATION AND EARTHWORK 4
3.2 EXTERIOR SLABS-ON-GRADE 5
3.3 RETAINING WALLS 6
3.4 DRILLED PIERS 7
3.5 SITE DRAINAGE 9
3.6 GENERAL 10
3.7 CONSTRUCTION 11
4.0 TECHNICAL DATA 12
5.0 STANDARD REPORT INFORMATION 12
6.0 CLOSURE 12

APPENDICES
Appendix A - FIELD EXPLORATION
Sample and Data Collection Information
Site and Exploration Location Map
Test Boring Logs

Appendix B - LABORATORY TESTING
Laboratory Testing Program
Laboratory Test Reports

Appendix C – TERMINOLOGY, CONVENTIONS AND REPORT INFORMATION
Glossary
General Notes
Classification of Soils for Engineering Purposes
Important Information about your Geotechnical Engineering Report

1.0 INTRODUCTION

1.1 EXECUTIVE SUMMARY

Based on information obtained from our subsurface exploration and laboratory testing of recovered samples, it is our opinion that the site is suitable for construction of the proposed Trona Valley Federal Credit Union Headquarters project. In general, our subsurface exploration encountered the following strata and conditions:

Soil at the project location consisted of fine-grained sand, silt and clay residuum with varying amounts of cementation and weathering. Sedimentary bedrock consisting of sandstone and claystone was encountered at depths ranging from 2.0 feet to 17.5 feet below ground surface (bgs). Surficial rock outcroppings are present across the property.

Groundwater was not encountered during drilling.

Specific geotechnical issues that were identified during the course of our subsurface exploration included the following:

1. On-site clay and clay with sand soils exhibit high collapse potential when subjected to an increase in moisture content. Three consolidation-swell tests were performed on in-situ samples obtained in the field at Boring locations B-4 at 2.5 feet bgs, B-11 at 2.5 feet bgs, and B-13 at 5.0 feet bgs. Samples demonstrated a collapse of 7.4%, 5.9% and 6.24%, respectively, when wetted under a vertical pressure of 1,000 psf.
2. A California Bearing Ratio, (CBR) test was completed using composite auger cuttings from depths of 0 to 5 feet at boring locations B-2, B-3, and B-6. The CBR test result yielded a value of 2.9 indicating a very poor to poor subgrade.

In summary, key geotechnical recommendations that apply to this project include:

1. Final site grading for the building footprint consists of variable cut and fill areas across the building layout and hydro-collapsable soils along the southern side of the building. Due to the potential risk of differential settlements and moisture induced settlements, it is our opinion that the new structure be supported on a system of deep foundations consisting of drilled concrete piers and suspended floor slabs.
2. Due to the presence of shallow bedrock, and some shallow rock layers, difficult excavation is anticipated in some areas. A line item should be included in bidding documents to account for difficult excavation.

1.2 PURPOSE AND SCOPE OF SERVICE

Inberg-Miller Engineers was requested by Trona Valley Federal Credit Union to perform a subsurface exploration and prepare this geotechnical engineering report for the purpose of providing recommendations for the design of a new headquarters building. Our specific scope of service is described by our February 4, 2025 Proposal and subsequent Amendments, as applicable.

2.0 CONDITIONS

2.1 SITE DESCRIPTION

The project site is located approximately ¼ mile Southeast of the I-80 overpass above College Drive in Rock Springs, Wyoming. The overall ground surface of the site slopes steeply towards the southwest. The site is bordered by sparce commercial property and underdeveloped land. The ground surface is covered by moderate growth of native grasses and sagebrush. Rock outcrops extended to ground surface at several locations across the site. A natural drainage ditch runs through the property draining towards the southwest. Known historic mining operations conducted by the Union Pacific Coal Co. took place beneath the property from 1868 to 1910 according to BRS, Inc in the Report dated April 9, 2024, and attached in Appendix A. Known abandoned mine shafts exist at 1,300 feet bgs. It is unconfirmed if coal seams at this property were mined 600 to 700 feet below ground surface. We defer to AML for any information regarding subsidence risk.

2.2 PROJECT CONDITIONS

Project conditions were either provided by Trona Valley Federal Credit Union or were assumed based on our experience with similar types of construction. These conditions are tabulated below and form the basis for recommendations provided within this report. Please contact Inberg-Miller Engineers if conditions differ from those stated.

Column Load Range (kips)	< 30 Kips
Wall Load Range (kips per foot)	1 to 3 kips per foot
Floor Loads (psf)	150 Psf
Other Loads: Walking Bridge Abutments	Unknown
Maximum Cut (feet) approximate	10′
Maximum Fill (feet) approximate	14′
Total Settlement Tolerance (inches)	1.0 inch
Differential Settlement Tolerance (inches per 50 feet)	0.5″/50′

2.3 SOIL/ROCK CONDITIONS

A summary of soil or rock conditions that were encountered and recorded on the logs is provided below. For a more detailed description of conditions refer to the test boring logs presented in Appendix A.

	Clay; Clay with Sand	Silty Sand Clayey Sand	Sandstone and Claystone Bedrock
USCS Classification	CL	SM, SC	-
Density/Consistency	Firm to hard	Very loose to dense	Weathered to hard
Boring Occurrence	Varies see logs	Varies see logs	Varies see logs
Vertical Limits	Varies see logs	Varies see logs	Varies see logs
Strength	Low to high	Low to high	High
Compressibility	Low to high	Low to high	Low
Permeability	Low	Moderate to high	Low
Moisture Sensitivity	Moderate to high	Moderate	Low to moderate
Frost Susceptibility	Moderate to high	Moderate	Low
Shrink-Swell Potential	Moderate to high	low	Low to moderate
Collapse Potential	Moderate to high	moderate	Low

Summary of Consolidation / Swell Testing

Soil Description	Test Results				
	Boring #	Depth (ft)	Volumetric Swell/Collapse (%)	Swell Pressure (psf)	Compression Index, Cc
CLAY	B-04	2.5′	-7.41%	0	0.148
CLAY with Sand	B-11	2.5′	-5.9%	0	0.179
CLAY with Sand	B-13	5′	-6.24%	0	0.146

2.4 GROUNDWATER CONDITIONS

At the time of our subsurface exploration, no groundwater was observed in the test borings before they were backfilled. Groundwater may be present at the site within the range of exploration depth but may not have been observable for numerous reasons such as low soil permeability or impeded drainage.

Groundwater conditions could change with seasonal or long-term changes in climatic conditions and post-construction changes in irrigation and surface water runoff. Generally,

developed sites have a significantly greater volume of water available to percolate into the ground due to irrigation and storm water runoff from hard surfaces. Localized, perched groundwater tables may develop above clay layers or bedrock, or within the foundation backfill zone.

3.0 RECOMMENDATIONS

3.1 SITE PREPARATION AND EARTHWORK

Site Preparation

Stripping Depth (inches)	6" or until all organic material is removed
Proof-Rolling	Pavement and slab subgrade, fill base

1. After stripping and excavating to the design subgrade elevation, proof-rolling should be performed with a wheeled vehicle exerting relatively high soil-contact pressure for the subject area, considering space constraints and access. Examples of suitable equipment include loaded dump trucks or end-loaders carrying a full bucket of soil.
2. Subgrades to receive structures, pavement, or fill material should respond uniformly to loading, and be free of organic materials, protruding rocks, debris, old fill, buried structures, or otherwise soft and compressible soil or material.
3. Weak or yielding subgrades should be repaired as recommended by the geotechnical engineer. Repairs may include soil excavation and replacement, possibly including proper geotextile fabric, depending on circumstances.

Fill and Backfill Materials

Classification	Suitable Materials	Source
Structural Fill	WYDOT Grading W, Envelope A	Imported
Pavement Base	WYDOT Grading W	Imported
Pavement Subbase	USCS - CL, SM, SC	On-site
Site Fill	Site Soil	On-site

1. Specification for recommended graded materials are as follows:

Structural Fill Envelope A		WYDOT Grading W Crushed Aggregate Base	
Sieve	**Percent Finer**	**Sieve**	**Percent Finer**
1½"	100	1½"	100
#4	50-100	1"	90-100
#8	30-90	½"	60-85
#30	15-75	#4	45-65
#50	10-60	#8	33-53
#200	0-20	#200	3-12
Liquid Limit < 40, PI < 15		**Liquid Limit < 25, PI < 3**	

Compaction

Below Pavements and Slabs	8-inch layers, 95% ASTM D698
Trenches	8-inch layers, 95% ASTM D698
Fill below structures	8-inch layers, 95% ASTM D698
Site Fill/Landscaped Areas	12-inch layers, 95% ASTM D698
Compaction Moisture Content	Moisture conditioned between -4 and +2 percentage points of the optimum moisture content

1. The contractor's equipment and procedures should produce a horizontal, uniformly mixed, and compacted lift. In-place density and water content of each lift of fill materials should be tested and approved, or as otherwise recommended by the geotechnical engineer.
2. If construction takes place during cold weather, care should be taken to prevent construction on frozen soils. In addition, fill materials should not contain snow and/or ice and should not be placed in a frozen condition.

Temporary and Permanent Slopes

Temporary Fill Slope	1.5 H: 1.0 V
Temporary Cut Slope	1.5 H: 1.0 V
Permanent Fill Slope	2.5 H: 1.0 V
Permanent Cut Slope	2.5 H: 1.0 V

1. Slopes, whether temporary (during construction) or permanent, will require careful management of surface water through design and maintenance to protect slopes from saturation.
2. Some slope conditions, especially when supporting structures or pavement loads, may have marginal safety factors against stability. Permanent and temporary slopes should be evaluated for stability when circumstances are better defined. Recommended values are provided for preliminary planning purposes only.
3. Slopes should be protected from erosion with vegetation, matting, or other measures.

3.2 EXTERIOR SLABS-ON-GRADE

Exterior slabs are subject to frost heave due to formation of ice lenses in underlying frost susceptible soils. The potential for frost heave may not be acceptable at doorways or other critical areas adjacent to the building that will be exposed to freezing weather. One approach to provide partial frost protection would be to place and compact a minimum of 24 inches of non-frost susceptible aggregate base course beneath the slab. Alternatively, if partial frost protection is unacceptable, over-excavation and aggregate base course replacement must be accomplished to the full frost depth of 48 inches. The aggregate base course should meet the requirement of WYDOT Grading W material. If the overexcavation and replacement method allows for surface water to saturate the base course, some frost heave may be expected.

3.3 RETAINING WALLS

Condition	Native site soil	Grading A Fill
Active Lateral Soil Pressure – for structures that can deflect without restraint by other structures (equivalent fluid unit weight, pcf)	42	40
At-Rest Lateral Soil Pressure - for structures that have significant restraint against deflection (equivalent fluid unit weight, pcf)	63	60
Passive Lateral Soil Pressure – resistance of soil abutting a structure (equivalent fluid unit weight, pcf)	375	460
Coefficient of Friction Between Foundation and Underlying Soil	.04	0.5
Soil Density, Wet Soil (pcf)	125	135

1. All of the parameters assume the structure and soils are above the water table. The following parameters do not include a factor of safety. A minimum factor of safety of 2.0 is recommended for horizontal loading.
2. Where possible, foundations should be backfilled and compacted evenly on all sides to prevent horizontal movement. Basement/crawl space walls and retaining walls should be adequately braced prior to backfilling.
3. Surcharge loads on the uphill side of the wall due to ground slope, soil stockpiles, equipment, and structures may significantly increase lateral forces on the wall and need to be fully evaluated.
4. Drains should be installed behind retaining walls or other confined areas where surface precipitation and runoff water can collect. Drains should be designed to prevent the build-up of hydrostatic pressures behind the retaining structures due to trapped water.

3.4 DRILLED PIERS

Due to the potential risk of differential settlements and moisture induced settlements, it is our opinion that the new structure be supported on a system of deep foundations. Drilled piers can be used to support the new building. Both axial and lateral design parameters are provided below; both conditions should be checked during the foundation design process.

Drilled Pier Recommendations

Embedment Layer	Sandstone/Claystone
Minimum Embedment Depth (ft)	5′ minimum into bedrock
Minimum Overall Length (ft)	15′ minimum length
Minimum Diameter (in)	18″
Drilling Conditions	Hard drilling conditions expected
Void Form Below Grade Beam/Cap	No, expansive soils are not expected
Minimum Frost Protection Depth (ft)	48″
Estimated Settlement Total (in) Differential/Span (in/ft)	 1.0″ 1.0″/50′

Drilled Pier Recommendations Cont.

Stratum Description	Clay, clay with sand	Silty Sand, Clayey Sand	Sandstone Claystone
Depth to Top of Layer (ft)	Ground surface	Ground surface	Varies see logs
Depth to Bottom of Layer (ft)	Varies see logs	Varies see logs	-
Embedment Layer	Yes/No	Yes/No	Yes/No
Allowable Skin Friction (compression) (psf) (Below 5′ bgs)	500	500	1,000
Allowable Skin Friction (tension) (psf) (Below 5′ bgs)	250	250	500
Allowable End Bearing (psf)	-	-	30,000

Input parameters of each Layer for LPILE series program are provided below for lateral load analysis.

LPILE v2019 Parameters	Clay, clay with sand	Silty Sand Clayey sand	Sandstone Claystone
LPILE Material Type	Stiff clay	Medium Sand	Weak Rock
Effective Unit Weight (pcf)	120	130	135
Friction Angle (deg)	-	33	-
Undrained Cohesion c (psf)	-	3.5	-
Unconfined Compressive Strength (psi)	-	7	500
Static Soil Modulus, k (pci)	60	500	-
Young's Modulus, (psi)	-	-	75,000
Strain, k_m	-	-	.0003
Rock Quality Designation (RQD %)	-	-	-

1. All loose soils and cuttings that accumulate in the bottom of the pier excavation should be removed prior to concrete placement. The importance of achieving clean pier excavation bottom prior to concrete placement cannot be overemphasized.

2. Groundwater that enters the pier hole may require control with casing. Water in excess of six (6) inches in the bottom of the pier excavation should be removed with a bucket drilling attachment, pumped out, or displaced with tremied concrete. In any case, concrete must fill the hole completely to full diameter and depth and with a clean, sound contact to surrounding soil or rock.

3. Once drilling and cleaning is complete, the pier excavations should be observed by the Geotechnical Engineer, or his representative. If any additional drilling, cleaning, and/or dewatering are recommended by the Geotechnical Engineer, it should be performed prior to concrete placement. If pier excavations cannot be cleaned to the satisfaction of the Geotechnical Engineer, or his representative, the recommended allowable end bearing pressures may no longer be valid at those foundation locations.

4. Once drilling, cleaning, and/or dewatering of the excavations are sufficiently complete according to Item 1 and 2 above, concrete should be placed immediately.

5. Cast-in-place concrete piers should fill the entire hole. Falling concrete should be directed so that it does not come in contact with the sidewall of the excavation and so that it has minimal contact with reinforcing steel. Concrete may need to be placed with a tremie or concrete pump, especially if groundwater is present in the hole.

6. Concrete placed in pier excavations should have a slump of 6 to 8 inches, while at the same time maintaining minimum 28-day strength requirements. The concrete piers should fill the entire hole. If casing is used, it should be left in place until it has been filled with a sufficient head of concrete to prevent water infiltration, soil sloughing or creation of voids when it is withdrawn.

Vertical Pier Design Parameters

Pier Group Design Recommendations

Reduction in pier capacity due to group interaction

Number of Piers in Group	Spaced at 2 pier diameters measured center to center	Spaced at 3 pier diameters measured center to center
4	25%	10%
9	35%	15%
16	50%	25%

1. Piers should not be placed closer than 2 pier diameters (measured center to center) apart.
2. Zero (0) % reduction applies to piers spaced at 4 pier diameters (measured center to center) or wider.
3. Linearly interpolate pier capacity reduction as needed for pier numbers and spacing other as provided.

3.5 SITE DRAINAGE

Consistent with the International Building Code (IBC), the ground surface adjacent to the structure should be sloped a minimum of 5% away from foundations within 10 feet of the building. If the slope adjacent to the structure is paved with asphalt or concrete, the slope can be reduced by 2%. Slope the ground surface beyond 10 feet of the building at least 2% away to pavement, ditch, or other positive drainage system. Negative drainage and improper management of near-surface water by not providing an effective grading and drainage design, can result in moisture entering building subgrade soils. Sources of near surface water may include pressurized irrigation and water supply lines, rainwater, snowmelt, and roof drains. Downspouts and roof drains should discharge at least 5 feet away from the building when the ground surface beneath such drains is not protected by exterior slabs or paving. Landscape irrigation within 10 feet of the building perimeter should be minimized or eliminated where positive drainage away from the building cannot be assured. Backfill against the footings and exterior walls and in utility trenches should be well compacted to reduce the potential for moisture infiltration.

If water is permitted to accumulate or pond next to the structure and penetrate the subgrade soils, larger soil movements may be experienced than those discussed in this report. These increased movements can result in undesirable differential settlements and floor slab/wall cracking. The estimated settlement values described in this report are dependent on positive drainage throughout the life of the structure and cannot be relied upon if effective drainage is not maintained.

To reduce the potential for surface water to impact foundation bearing soils within the portion of the building where the basement is located, installation of a perimeter drainage system is recommended. The drainage system should be constructed around the exterior perimeter of the building foundation and sloped at a minimum 1/8 inch per foot to a suitable outlet providing positive drainage. The drainage system should consist of a properly sized perforated pipe (minimum 4-inch I.D.) embedded in free-draining gravel and placed in a trench at least 12 inches in width and height. The top 1 foot of backfill should be a low permeability soil. The system should be underlain with a polyethylene moisture barrier, sealed to the foundation

walls, and extended at least to the edge of the backfill zone. The gravel should be encapsulated with drainage fabric prior to placement of remaining foundation backfill. Design of the drainage system is beyond our scope of services; however, see figure 1 for a drainage detail example.

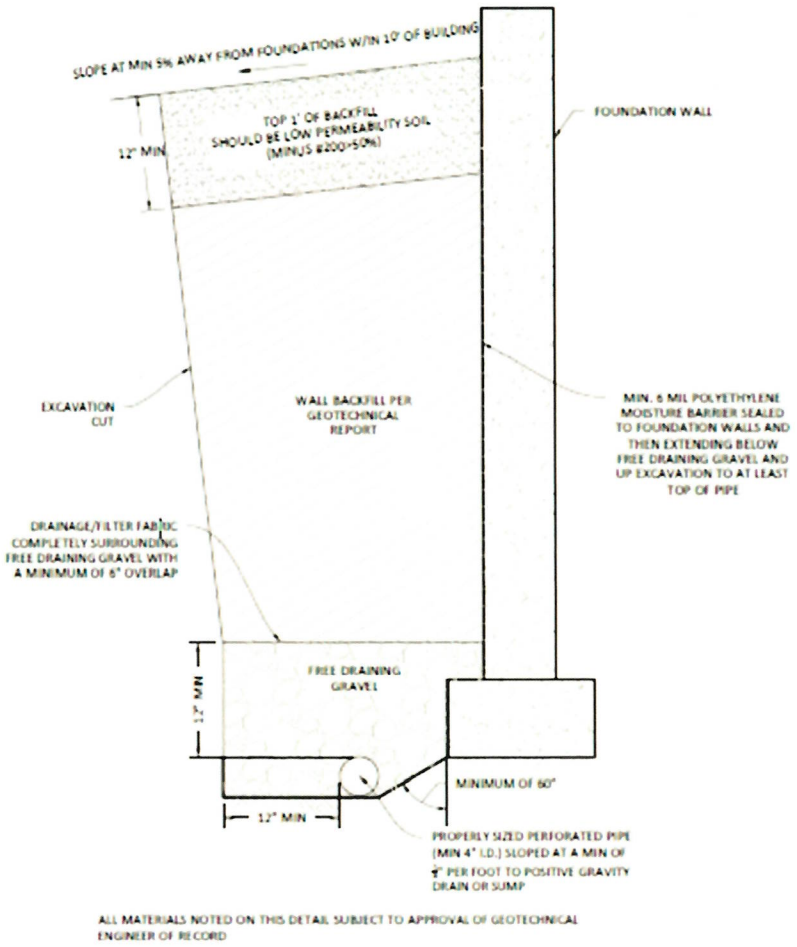


Figure 1: Foundation Drain Detail

3.6 GENERAL

Cement Type	**No Type Restriction**
Dissolved Sulfate in Water (ppm) Ordinary Portland Cement (OPC) Portland Limestone Cement (PLC)	**(0-50 ppm) (B-10, B-9, @ 2.5')** W.S.S.<1,000ppm - No Type Restriction (ASTM C150) W.S.S.<1,000ppm - No Type Restriction (ASTM C595)
International Building Code Seismic Site Class	Site Class C
Site Surface Drainage	See Section 3.5 – Site Drainage
Seepage Protection	Potential seepage should be captured and directed away from the structure by perimeter drain.
Landscaping and Irrigation	Minimized or eliminated within 10 feet of the structure.

According to ACI 318-19, sulfate exposure classes which require the use of Type II or Type IL/MS cement as recommended in the table above should have a minimum compressive strength of 4,000 psi and a maximum water to cement ratio of 0.50.

Inberg-Miller Engineers should review final plans and specifications in order to determine whether the intent of our recommendations has been properly implemented. In addition, we should be retained as the geotechnical engineer and construction materials testing agency to provide the following services:

a. Observe excavations to determine if subsurface conditions revealed are consistent with those discovered in the exploration.

b. Identify if the proper bearing stratum is exposed at proposed foundation excavation depths.

c. Observe that foundation excavations are properly prepared, cleaned, and dewatered prior to concrete placement.

d. Test compaction of subgrades and fills.

e. Perform field and laboratory testing of concrete and other materials as required by project specification and/or building code.

3.7 CONSTRUCTION

Excavation Difficulty	Due to the presence of shallow bedrock, and some shallow rock layers, difficult excavation is anticipated in some areas.
Dewatering Requirements	Not anticipated
Soil Sensitivity	Moisture conditioning may be time and resource intensive.
OSHA Soil Type	Type C
Casing Requirements for Drilled Shafts	Not anticipated, but may be needed of soil sloughing is encountered.
Potential for Buried Obstructions	Natural gas pipeline runs through the property and across the location of proposed roadways.
Protection of Existing Structures	N/A
Onsite Borrow Soil	Onsite native material.

Excavations should be sloped, benched, shored, or made safe for entry by the use of trench boxes, as required by the standards of 29 CFR Part 1926. As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance equal to the slope height, from the crest of the slope. The contractor is solely responsible for designing and constructing stable excavations, the geometry of the excavation slopes, and the protective equipment and procedures employed by his forces. For the sole purpose of project planning, we recommend that clay and sand soils are considered OSHA Type C soils. Excavations, including utility trenches, extending to depths of greater than 20 feet are required to have side slopes, trench boxes, or shoring designed by a professional engineer licensed in the state of Wyoming.

4.0 TECHNICAL DATA

Our Sample and Data Collection Information, Site and Boring Location Map, and Test Boring Logs are included in Appendix A.

5.0 STANDARD REPORT INFORMATION

Our Field and Laboratory Testing Program and Testing Data laboratory reports are included in Appendix B.

Our Standard Report Information, including Terms and Definitions, Limitations, and Comments Form are included in Appendix C.

6.0 CLOSURE

This report has been prepared for the exclusive use of our client, Trona Valley Federal Credit Union, for evaluation of the site, design, and construction planning purposes of the described project. All information referenced in the Table of Contents, as well as any future written documents that address comments or questions regarding this report, constitute the "entire report." Inberg-Miller Engineers' conclusions, opinions, and recommendations are based on the entire report. This report may contain insufficient information for applications other than those herein described. Our scope of services was specifically designed for and limited to the specific purpose of providing geotechnical recommendations for the design of the proposed Trona Valley Federal Credit Union New Headquarters project. Consequently, this report may contain insufficient information for applications other than those herein described.

The recommendations in this report are based on the subsurface conditions encountered at the test borings at the time they were drilled. The readers of this geotechnical engineering report should realize that subsurface variations and anomalies can and will exist across the site and between the test borings. The readers should also realize that site conditions will change due to the modifying effects of seasonal, climatic and construction conditions.

We caution that this report was not written as a construction contract document, and therefore should either not be incorporated in contract documents or be accompanied by a statement similar to the following:

This report was used during the planning and design of the subject project and is provided in the contract documents for informational purposes only. This report may contain recommendations that were not implemented and terms that conflict with the contract documents, therefore the project plans and technical specifications and not this report should be followed for construction requirements.

We appreciate participating in your project. We can offer services under a separate contract to provide civil or environmental engineering services, review final plans and specifications, perform construction surveying, field and laboratory construction materials testing, and observe excavations, as may be required. Please call us at 307-875-4394 if you have any questions regarding this report.

Appendix A

SAMPLE AND DATA COLLECTION INFORMATION

Field-sampling techniques were employed in this exploration to obtain the data presented in the Final Logs and Report generally in accordance with ASTM D420, D1452, D1586 (where applicable), and D1587 (where applicable).

The drilling method utilized in most test borings is a dry-process, machine rotary auger type that advances hollow steel pipe surrounded by attached steel auger flights in 5-foot lengths. This method creates a continuously cased test hole that prevents the boring from caving in above each level of substrata to be tested. Sampling tools were lowered inside the hollow shaft for testing in the undisturbed soils below the lead auger. In some test borings, as appropriate to advance to the desired depth, air or wash rotary drilling methods were utilized. Air or wash rotary drilling methods allow for the extraction of rock core samples.

Samples were brought to the surface, examined by an IME field representative, and sealed in containers (or sealed in the tubes) to prevent a significant loss of moisture. They were returned to our laboratory for final classification per ASTM D2487 methods. Some samples were subjected to field or laboratory tests as described in the text of this report.

Groundwater observations were made in the open drill holes by IME field personnel at the times and dates stated on the Final Logs. Recorded groundwater levels may not reflect equilibrium groundwater conditions due to relatively low permeability of some soils. It must also be noted that fluctuations may occur in the groundwater level due to variations in precipitation, temperature, nearby site improvements, nearby drainage features, underdrainage, wells, severity of winter frosts, overburden weights, and the permeability of the subsoil. Because variations may be expected, final designs and construction planning should allow for the need to temporarily or permanently dewater excavations or subsoil.

A Final Log of each test pit or boring was prepared by IME. Each Final Log contains IME's interpretation of field conditions or changes in substrata between recovered samples based on the field data received, along with the laboratory test data obtained following the field work or on subsequent site observations. The final logs were prepared by assembling and analyzing field and laboratory data. Therefore, the Final Logs contain both factual and interpretive information. IME's opinions are based on the Final Logs.

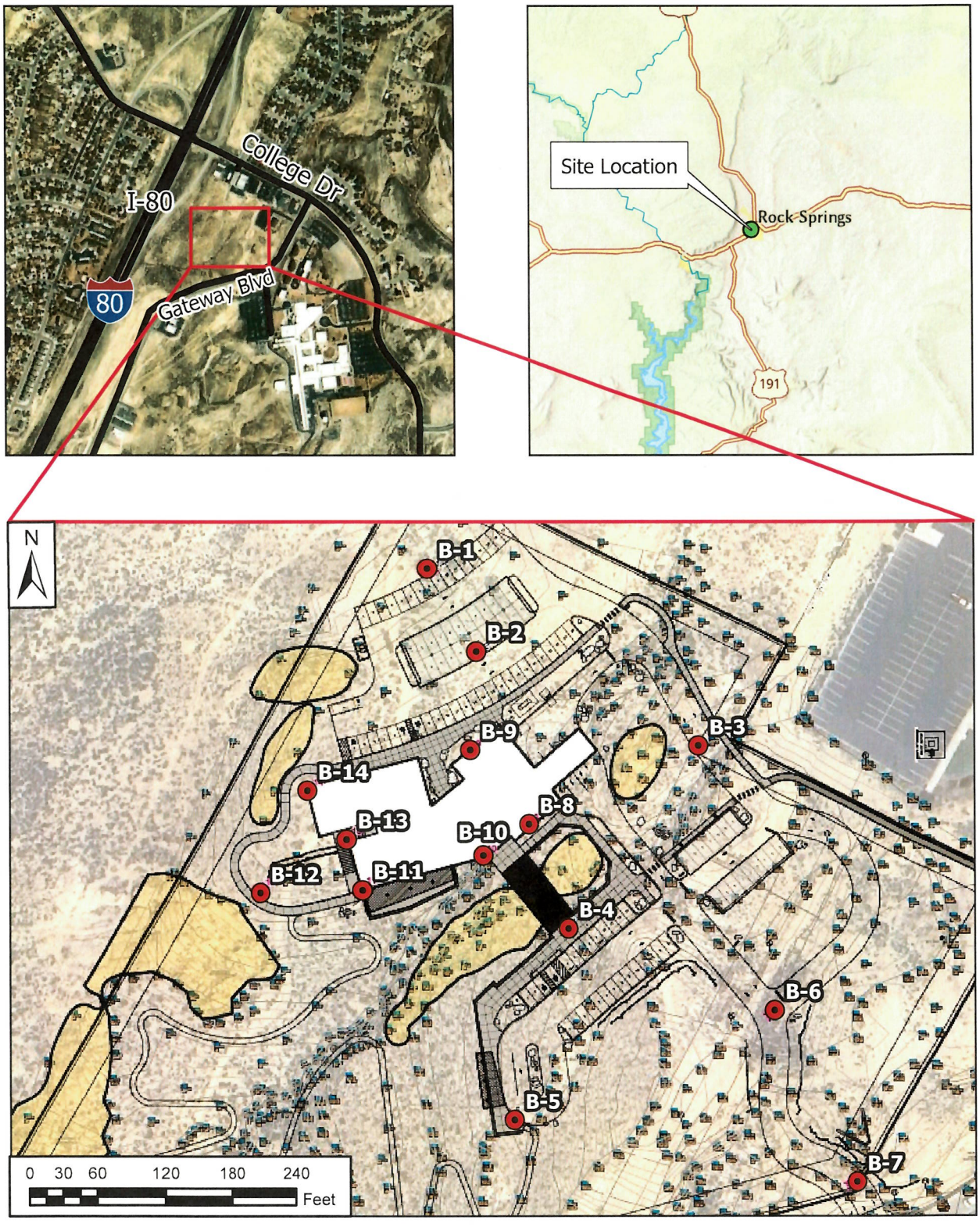
The Final Logs list boring methods, sampling methods, approximate depths sampled, amounts of recovery in sampling tools (where applicable), indications of the presence of subsoil types, and groundwater observations and measurements. Results of some laboratory tests are arrayed on the Final Logs at the appropriate depths below grade. The horizontal lines on the Final Logs designate the interface between successive layers (strata) and represent approximate boundaries. The transition between strata may be gradual.

We caution that the Final Logs alone do not constitute the report, and as such they should not be excerpted from the other appendix exhibits or from any of the written text. Without the written report, it is possible to misinterpret the meaning of the information reported on the Final Logs. If the report is

reproduced for reference purposes, the entire numbered report and appendix exhibits should be bound together as a separate document, or as a section of a specification booklet, including all drawings, maps, etc.

Pocket penetration tests taken in the field, or on samples examined in the laboratory are listed on the Final Logs in a column marked "qp." These tests were performed only to approximate unconfined strength and consistency when making comparisons between successive layers of cohesive soil. It is not recommended that the listed values be used to determine allowable bearing capacities. Bearing capacities of soil is determined by IME using test methods as described in the text of the report.

TVFCU Headquarters - Site Location Map



Maxar, Microsoft, Esri, CGIAR, USGS, Sources: Esri, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Maxar


VETERANS PARK
WRIGHT PARK
PETERNELL PARK
NORTH SIDE BELT ROUTE
EL RANCHO TRAILER PARK
RAUZI TRAILER PARK
BITTER CREEK
BITTER CREEK CHANNEL
CIVIC CENTER
WASHINGTON ELEMENTARY
LOWELL ELEMENTARY
ROCK SPRINGS HIGH SCHOOL
LINCOLN ELEMENTARY
EAST JR. HIGH
BUNNING PARK
PEARL PARK
GARNET STREET PARK
POWER HOUSE ROAD
JAMES DRIVE
LIBERTY DRIVE
YALECREST DRIVE
COTTONWOOD DRIVE
EDGAR STREET
COLLINS STREET
PIONEER STREET
McCABE ST.
POTTER ST
BRIDGER AVE
EVANS ST.
NOBLE ST
SECOND ST.
O'DONNELL ST.
PILOT BUTTE
23
24
26
25
35
36

BRS, Inc.
1130 Major Ave.
Riverton, WY 82501
E-Mail: brs@brsengineering.com
307-857-3079 Fax: 307-857-3080

City of Rock Springs, Wyoming
Utility Review
Wyoming Abandoned Mine Lands

To:	Utility Review Committee
From:	Ryan Reed, BRS Inc., P.E.
Date:	4/9/2024
Project #:	N/A
Project Address:	Parcel 1905-27-4-00-014-00

I, Ryan Reed, have reviewed the Project location(s) in relation to potential for abandoned mine subsidence and determined:

- ☒ Property is undermined by abandoned mine workings at an approximate depth of 1,300 Feet
- ☐ Property is adjacent to abandoned mine workings at an approximate depth of_____
- ☐ Property is not impacted by any known abandoned mine workings.

Based upon potential for abandoned mine subsidence:

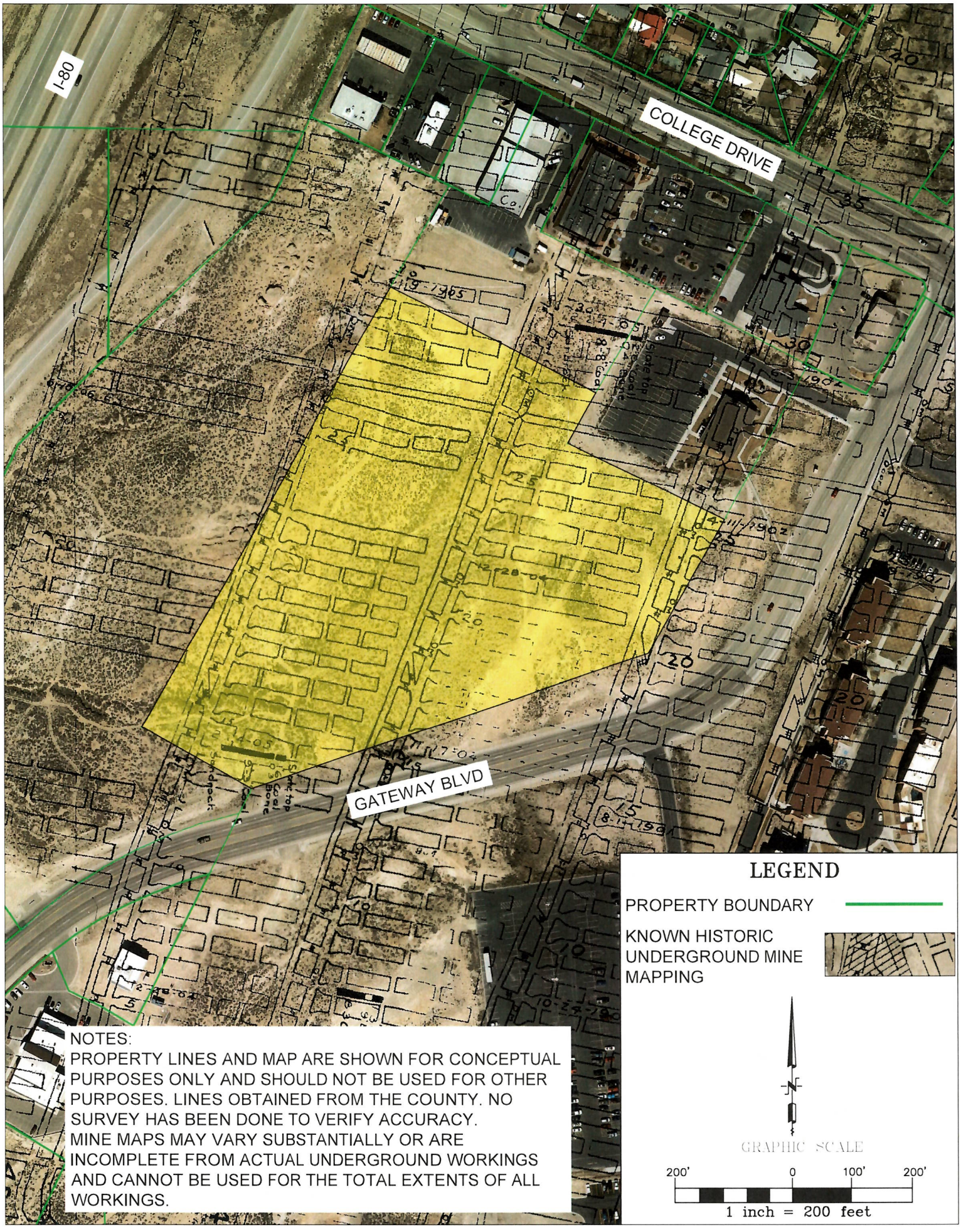
- ☐ It is Recommended that Remediation efforts be made at the Project location(s).
- ☐ It is Recommended that Exploratory Drilling be completed at the Project location(s).
- ☒ No Remediation Action is Recommended at this time.

Other Comments/Issues:

Property is shown to be undermined by the Union Pacific Coal Co. Rock Springs No. 1 Mine by known historic mine mapping. The UPCC Rock Springs No. 1 Mine operated from 1868 to 1910. The mine is located in the Rock Springs #1 Coal Seam and at this property would be approximately 1,300 feet below the ground surface. No drilling data is available in the area that reaches the depth of this coal seam. The Rock Springs #6 Coal Seam is the uppermost seam that was historically mined in the Rock Springs District and if that coal seam was mined at this property, it would be approximately 600 to 700 feet below ground surface.

Signature

4/9/2024
Date


I-80
COLLEGE DRIVE
GATEWAY BLVD
LEGEND
PROPERTY BOUNDARY
KNOWN HISTORIC UNDERGROUND MINE MAPPING
N
GRAPHIC SCALE
200' 0 100' 200'
1 inch = 200 feet
NOTES:
PROPERTY LINES AND MAP ARE SHOWN FOR CONCEPTUAL PURPOSES ONLY AND SHOULD NOT BE USED FOR OTHER PURPOSES. LINES OBTAINED FROM THE COUNTY. NO SURVEY HAS BEEN DONE TO VERIFY ACCURACY.
MINE MAPS MAY VARY SUBSTANTIALLY OR ARE INCOMPLETE FROM ACTUAL UNDERGROUND WORKINGS AND CANNOT BE USED FOR THE TOTAL EXTENTS OF ALL WORKINGS.

TEST BORING B-01

INBERG-MILLER ENGINEERS — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59523°, -109.24062°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Medium dense to dense, dry, redish brown, Silty SAND			0 50 100 21 60 43 50/3" 50/5"				0 20 40 60 4 7 8		
	4.5										
	5	Hard, dry, brown, CLAY with Sand									
	7.0										
		Weathered to hard, gray, CLAYSTONE									
	10										
	11.4										

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	11.4
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-02

INBERG-MILLER ENGINEERS — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59503°, -109.24046°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft):			0 50 100					0 20 40 60	
	0	Stiff to very stiff, dry, brown to redish brown, CLAY with Sand			17, 24					6	
	4.5										
	5	Very stiff to hard, dry, gray, CLAY			31, 67					6	
	9.0										
	10	Weathered to hard, brown, SANDSTONE			50/5"					3	
	10.9										

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	10.8
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-03

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59479°, -109.23973°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Medium dense, dry, brown, Silty SAND with Clay			0 50 100 13 19 50/5" 50/1" 50/3"				0 20 40 60 9 7 9		
	3.0	Stiff, dry, gray, CLAY									
	5.0	Weathered, gray, CLAYSTONE									
	7.5	Weathered to hard, brown, SANDSTONE									
	10	10.3									

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	10.3
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-04

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59435°, -109.24017°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):											
	0	Loose, moist, brown, Silty SAND 1.0			15, 22					10	
		Firm to stiff, dry, gray, CLAY									
	5	5.5			18, 35, 50/5"					7, 5	
		Stiff to very stiff, dry, redish brown, CLAY with Sand									
	10	10.0									
		Weathered to hard, gray, CLAYSTONE			50/3"						
	15										
	20	20.3			50/3"						

Remarks:

Date Begun:	3/6/25
Date Completed:	3/6/25
Termination Depth (ft):	20.3
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

- Split Spoon
- Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS

While Drilling (ft)	N/A
End of Drilling(ft)	N/A
Depth to Cave In (Ft):	N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-05

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59388°, -109.24036°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Very loose to medium dense, dry, redish brown, Silty SAND			0 50 100 15 3 12 17 45				0 20 40 60 7 6 6		One blow for 6" at 3 feet
	5										
		7.0									
	10	Stiff to hard, dry, brown, CLAY with Sand									
		11.5									

Remarks:

Date Begun:	3/6/25
Date Completed:	3/6/25
Termination Depth (ft):	11.5
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-06

INBERG-MILLER ENGINEERS — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59415°, -109.23949°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION (Surface Elevation (Ft):)	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
	0	Dense, dry, brown, Silty SAND			0 50 100				0 20 40 60		
	2.0	Weathered to hard, brown, SANDSTONE			49 50/5"				7		
	5				50/4"				6		No Sample recovered at 7.5 feet
					50/2"						
	10	10.1			50/4"				6		

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	10.1
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-07

INBERG-MILLER ENGINEERS — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59372°, -109.23922°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION (Surface Elevation (Ft):)	GRAPHIC / SAMPLE TYPE / RECOVERY	N BLOWS PER Ft (0 50 100)	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT (PL — LL) (0 20 40 60)	OTHER TESTS AND NOTES
	0	Medium dense, dry, brown, Clayey SAND		12					3	
	2.5	Medium dense, dry, black, COAL Seam		12						
	4.0	Very stiff, dry, gray, CLAY								
	5									
	6.0	Hard, brown, SANDSTONE Rock		22					7	
	6.5			50/1"						Auger refusal at 6.5 feet. No sample recovered

Remarks:

Date Begun:	3/6/25
Date Completed:	3/6/25
Termination Depth (ft):	6.6
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-08

INBERG-MILLER ENGINEERS — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.5946°, -109.2403°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION (Surface Elevation (Ft):)	GRAPHIC / SAMPLE TYPE / RECOVERY	N BLOWS PER Ft (0 50 100)	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT (PL — LL) (0 20 40 60)	OTHER TESTS AND NOTES
	0	Medium dense, dry, brown to redish brown, Silty SAND		18, 14	2	77	21	7		SM Non-Plastic
	5			11, 12	11	54	35	2		SM Non-Plastic
	10			12				3		
	13.0	Weathered to hard, redish brown, SANDSTONE		50/5"						
	15									
	20			50/5"				6		
	25			50/5"						
	25.0	Hard, gray CLAYSTONE								
	30			50/5"	0	3	97	14		CH LL= 53 PL= 28 PI= 25
	30.4									

Remarks:

Date Begun:	3/5/25
Date Completed:	3/5/25
Termination Depth (ft):	30.4
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-09

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59479°, -109.24049°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Firm to hard, dry, tan to gray, CLAY with Sand			14, 31, 40, 44				7, 5		
	9.0										
	10	Medium dense, dry, redish brown, Silty SAND			22, 19				4		
	17.5										
	20	Weathered to hard, gray, CLAYSTONE			50/4"				8		One blow for 5" at 15 feet
	25				50/1"						No sample recovered at 25 feet
	30				50/1"						No sample recovered at 30 feet
	30.1										

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	30.1
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-10

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59453°, -109.24045°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft):			0 50 100					0 20 40 60	
	0	Stiff, dry, gray, CLAY			17					4	
		2.0			12						
		Medium dense, dry, redish brown, Silty SAND									
		4.5			22					3	
	5	Firm to hard, dry, gray, Clay			10	0	0	100			CL LL= 44 PL= 20 PI= 25
	10	Grades sandy at 10 feet			19					12	
		13.0									
		Weathered to hard, redish brown to gray, CLAYSTONE			57						
	15										
	20				50/5"					7	
	25				50/5"						
	30	30.6			50/1"					10	

Remarks:

Date Begun:	3/5/25
Date Completed:	3/5/25
Termination Depth (ft):	30.6
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-11

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59445°, -109.24084°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft):									
	0	Medium dense, dry, brown, Silty SAND			11, 55				4		
	2.0	Hard, dry, tan to gray, CLAY with Sand			50, 55, 65	0	21	79	8, 5		CL LL= 27 PL= 17 PI= 10
	15.0	Weathered to hard, gray, CLAYSTONE			50/5"				8		
	20				50/2"						No sample recovered at 20 feet
	25				50/1"						No sample recovered at 25 feet
	30	30.1			50/1"						No sample recovered at 30 feet

Remarks:

Date Begun:	3/5/25
Date Completed:	3/5/25
Termination Depth (ft):	30.1
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

- Split Spoon
- Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS

While Drilling (ft)	N/A
End of Drilling(ft)	N/A
Depth to Cave In (Ft):	N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-12

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59444°, -109.24117°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
		Surface Elevation (Ft):			0 50 100					0 20 40 60	
	0	Very loose, dry, brown, Silty SAND			4					11	
		1.0									
		Very soft to very stiff, dry, gray to redish brown CLAY			27						
	5	Grades sandy at 5 feet			29					8	
		6.5									

Remarks:

Date Begun:	3/5/25
Date Completed:	3/5/25
Termination Depth (ft):	6.5
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

☒ Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-13

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59457°, -109.24089°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Very loose, moist, brown, Silty SAND			0 50 100					0 20 40 60	
	1.0	Stiff to very stiff, dry, gray, Clay with Sand			15, 27, 43, 30					10, 7	
		Grades less sand at 2.5 feet									
	5										
	9.5	Weathered to hard, gray CLAYSTONE			50/5"	0	24	76		7	CL LL= 29 PL= 16 PI= 13
	10				50/5"					7	
	15				50/1"						
	20				50/3"						
	24.0	Hard, redish brown, SANDSTONE									
	25										
	30				50/3"					7	
	30.3										

Remarks:

Date Begun:	3/5/25
Date Completed:	3/5/25
Termination Depth (ft):	30.3
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

- Split Spoon
- Drive Sampler, 2.41-I.D.

WATER LEVEL OBSERVATIONS

While Drilling (ft)	N/A
End of Drilling(ft)	N/A
Depth to Cave In (Ft):	N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

TEST BORING B-14

INBERG-MILLER ENGINEERS — IME — QUALITY SOLUTIONS THROUGH TEAMWORK

Project: TVFCU Headquarters
Location: Rock Springs, WY
41.59469°, -109.24101°

Job No.: 24624-GX
Client: Trona Valley Federal Credit Union

ELEVATION	DEPTH (ft)	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE RECOVERY	N BLOWS PER Ft	Qp (TSF)	% GRAVEL	% SAND	% -200	WATER CONTENT PL LL	OTHER TESTS AND NOTES
Surface Elevation (Ft):	0	Medium dense, moist brown, Silty SAND			13, 27					12	
	1.0	Very stiff, dry, gray, CLAY									
	4.0	Dense, dry, brown, Silty SAND			54, 50/3"	8	44	47		4	SC LL= 25 PL= 17 PI= 8
	8.0	Rock Layer at 7.5 feet Weathered, gray, CLAYSTONE			62, 50/4"	0	2	98		9, 5	CL LL= 43 PL= 22 PI= 22
	13.0	Hard, redish brown, SANDSTONE			50/1"						No sample recovered at 20 feet
					50/1"						No sample recovered at 25 feet
	30.1				50/1"						No sample recovered at 30 feet

Remarks:

Date Begun:	3/4/25
Date Completed:	3/4/25
Termination Depth (ft):	30.1
Crew:	JEI, MKP
Rig:	CME 55
Method:	3 1/4" Hollow Stem Auger
Benchmark/Datum (Ft):	

SAMPLE TYPES

Split Spoon

WATER LEVEL OBSERVATIONS

While Drilling (ft) N/A

End of Drilling(ft) N/A

Depth to Cave In (Ft): N/A

LOG OF TEST BORING OR TEST PIT 24624-GX BORING LOGS.GPJ INB_MLLR 6-23-10.GDT 5/14/25

Appendix B

LABORATORY TESTING PROGRAM

Soil samples were transported to our laboratory where they were subject to further evaluation, which may include visual classification according to ASTM D2488 or other analysis to determine certain engineering properties. Tests were performed in accordance with the test methods listed below.

Laboratory Test	Test Method
Moisture Content	ASTM D2216
Liquid Limit, Plastic Limit and Plasticity Index	ASTM D4318
Sieve Analysis	ASTM C117
Sieve Analysis with Hydrometer	ASTM D422
Sieve Analysis (200 Sieve only)	ASTM D1140
Water Soluble Sulfate	Comparative
Unconfined Compressive Strength	ASTM D2166
Moisture-Density Relationship (Standard Proctor)	ASTM D698
Moisture-Density Relationship (Modified Proctor)	ASTM D1557
California Bearing Ratio (CBR)	ASTM D1883
Hydraulic Conductivity	ASTM D5084
Minimum Resistivity	AASHTO T288
pH	AASHTO T288
Tube Density	ASTM D2937
Direct Shear	ASTM D3080
Consolidation-Swell	ASTM D2435

Test results that are not displayed on the test boring logs are presented in Appendix B of this report.

CALIFORNIA BEARING RATIO

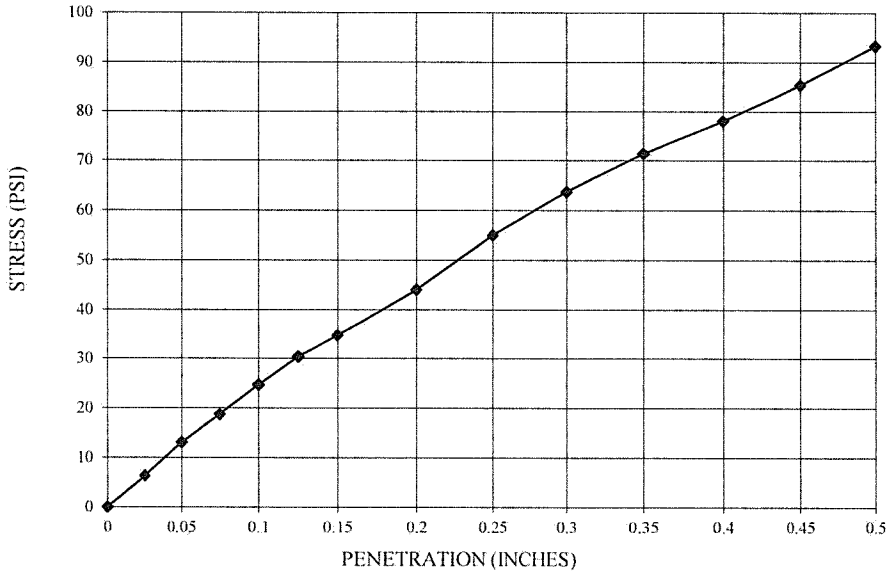
ASTM D1883

Client: Trona Valley FCU
Address:
Attention:

IME Project No: 24624-GX
Project Name: Headquarters
Project Location:
Sample Location/ID:

IME Sample No: 1
Sampled By: IME
Sample Date/Time:
Date Received in Lab:
Type of Material: Soil
Source: B6,3,&2 0-5' Auger Cuttings
Sample Description: Tan Clay and fine sand

Tested By:
Test Date:



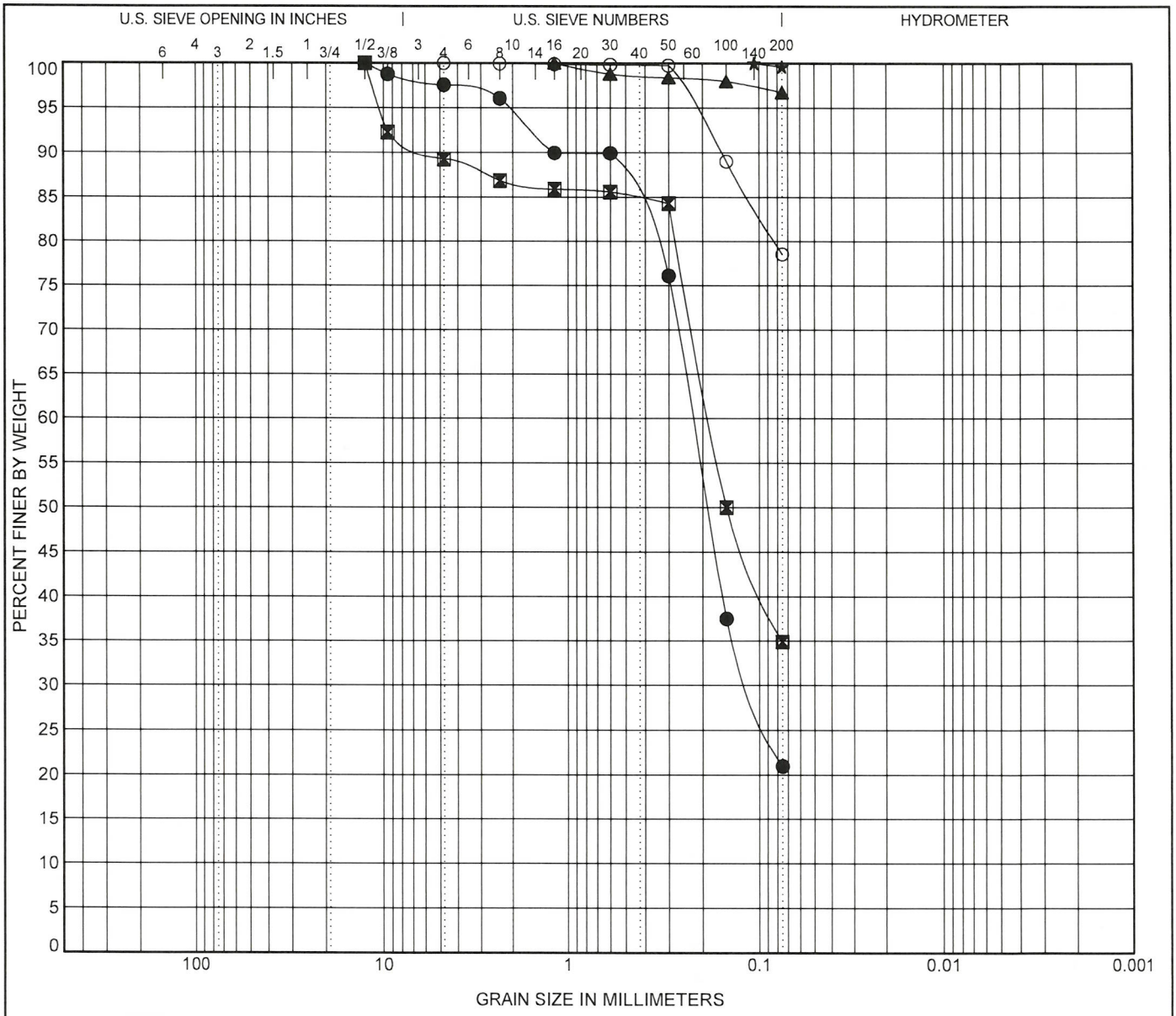
BEFORE SOAKING	
Moist. Content (%):	11.3
Dry Density (PCF):	115.2

Standard A	
Opt. Moist. Content (%):	11.1
Max. Dry Density (PCF):	121.8

AFTER SOAKING	
Moist. Content (%):	15.7
Dry Density (PCF):	114.9

TEST RESULTS	
Compaction of Sample (%):	94.6
California Bearing Ratio:	2.9

Inberg-Miller Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-08	2.5	SILTY SAND(SM)	NP	NP	NP		
⊠	B-08	7.5	SILTY SAND(SM)	NP	NP	NP		
▲	B-08	30.0	FAT CLAY(CH)	53	28	25		
★	B-10	7.5	LEAN CLAY(CL)	44	20	24		
⊙	B-11	2.5	LEAN CLAY with SAND(CL)	27	17	10		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-08	2.5	12.5	0.225	0.11		2.5	76.6	21.0	
⊠	B-08	7.5	12.5	0.184			10.8	54.3	34.9	
▲	B-08	30.0	1.18				0.0	3.3	96.7	
★	B-10	7.5	0.106				0.0	0.4	99.6	
⊙	B-11	2.5	4.75				0.0	21.5	78.5	

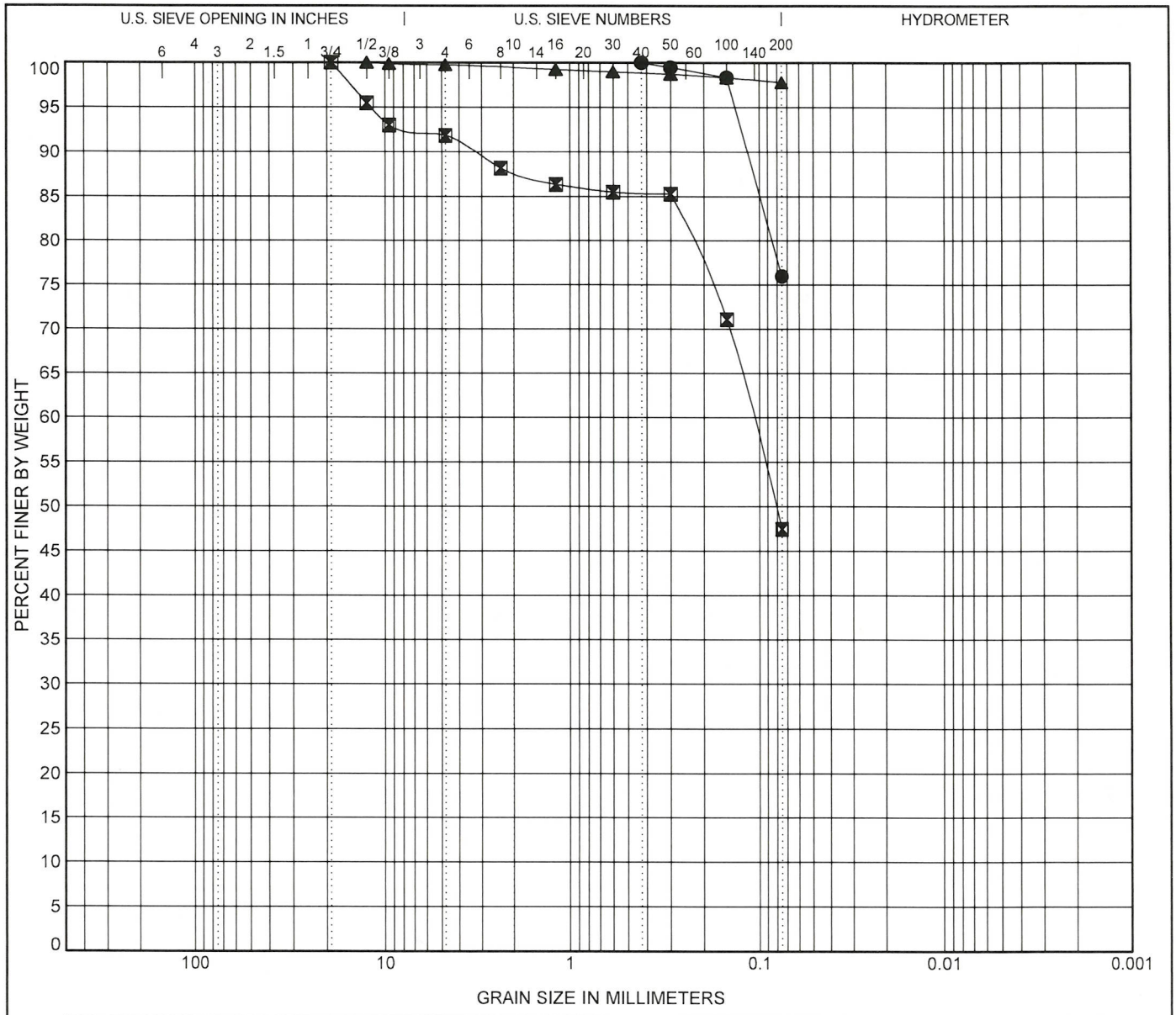
PROJECT: TVFCU Headquarters
JOB NO.: 24624-GX
CLIENT: Trona Valley Federal Credit Union
TEST METHOD: ASTM D422

PARTICLE SIZE ANALYSES

IME

US_GRAIN_SIZE 24624-GX BORING LOGS.GPJ US_LAB.GDT 4/11/25

INBERG-MILLER ENGINEERS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-13	10.0	LEAN CLAY with SAND(CL)	29	16	13		
⊠	B-14	5.0	CLAYEY SAND(SC)	25	17	8		
▲	B-14	10.0	LEAN CLAY(CL)	43	22	21		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-13	10.0	0.425				0.0	24.0	76.0	
⊠	B-14	5.0	19	0.108			8.2	44.4	47.4	
▲	B-14	10.0	12.5				0.3	2.0	97.8	

PROJECT: TVFCU Headquarters
JOB NO.: 24624-GX
CLIENT: Trona Valley Federal Credit Union
TEST METHOD: ASTM D422

PARTICLE SIZE ANALYSES

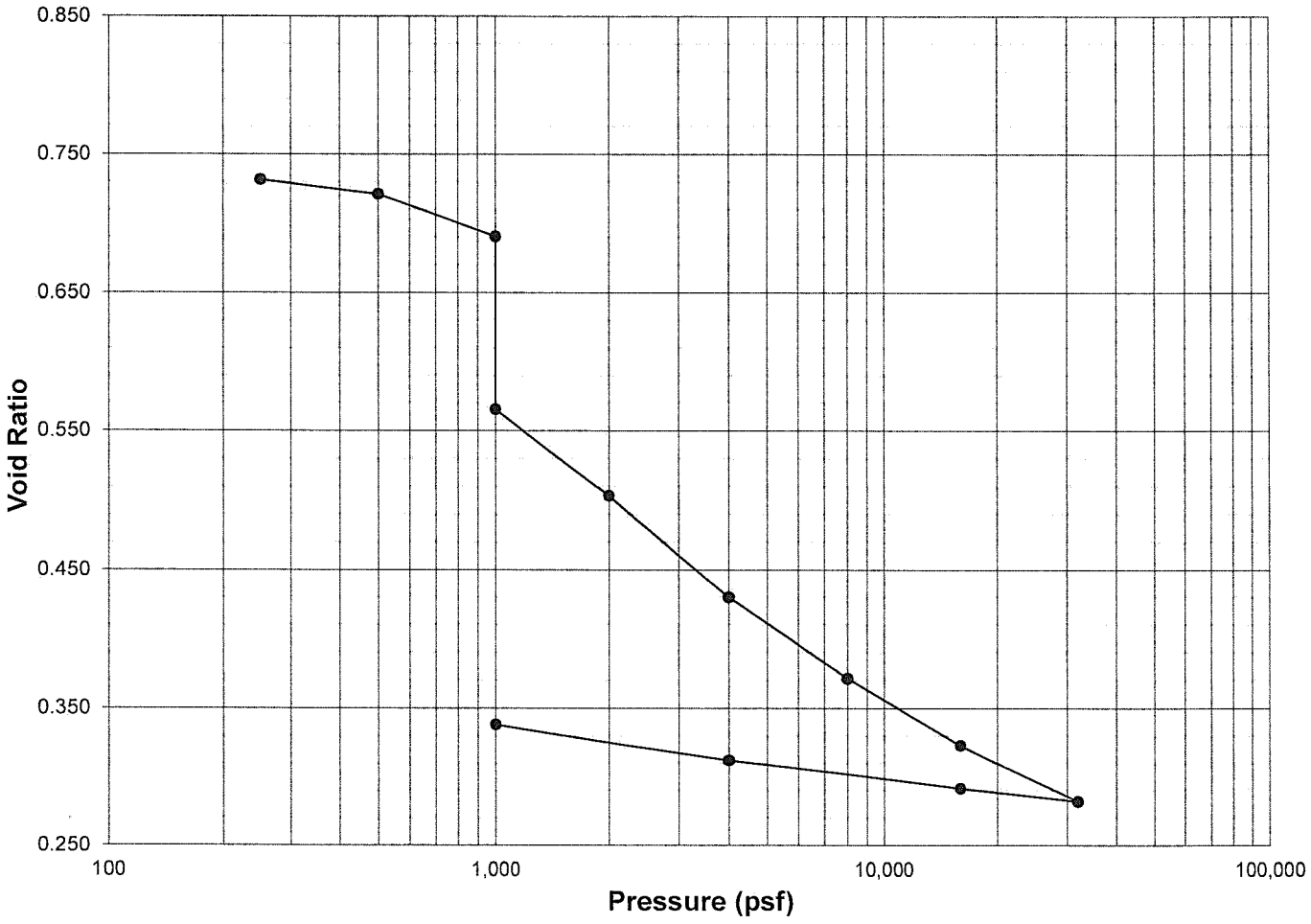
INBERG-MILLER ENGINEERS

US_GRAIN_SIZE 24624-GX BORING LOGS.GPJ US_LAB.GDT 4/11/25

CONSOLIDATION-SWELL TEST

ASTM D2435

Project:	Headquarters Final Geotech	Client:	Trona Valley FCU
Job No:	24624-GX	Test Date:	4/10/2025
Sample No:	B-4	Depth (ft):	2.5



Soil Description: Gray Lean CLAY

Specimen Diameter:	2.41	in.
Specimen Height:	1.00	in.
Overburden Pressure (Po):	268.9	psf
Preconsolidation Pressure (Pp):	1000	psf
Overconsolidation Ratio: (OCR = pp/po)	3.7	

Liquid Limit (%):		
Plastic Limit (%):		
Plasticity Index (%):		

	Initial	Final
Moisture Content:	10.5%	16.7%
Saturation:	39%	120%
Wet Density (pcf):	107.6	142.7
Dry Density (pcf):	97.3	122.3

Comp. Index (Cc):	0.148				
Consol. Index (Cr):	0.039				

Swell Pressure: psf

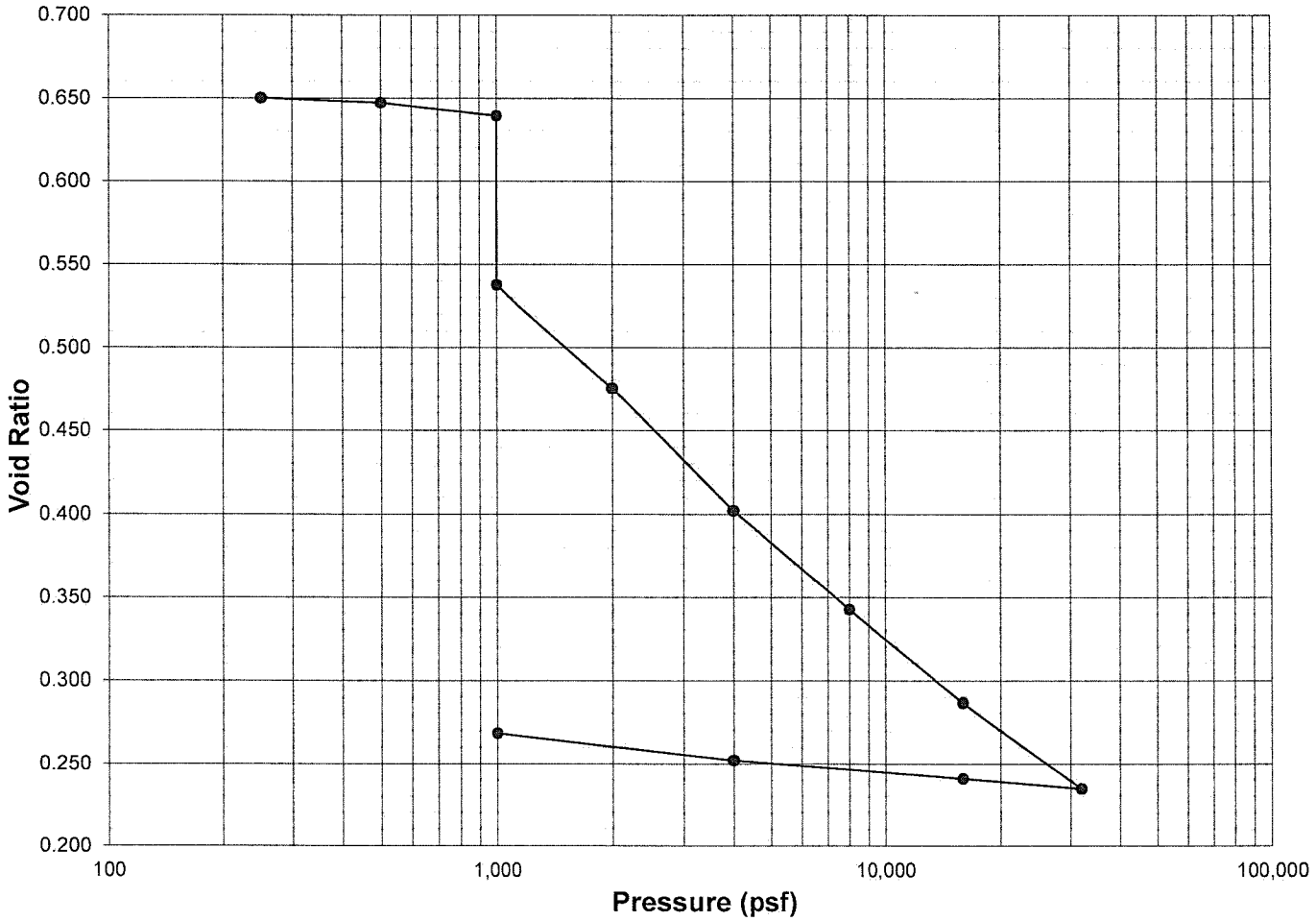
Percent Swell or Collapse*: -7.41% (- indicates collapse) Pressure when wetted: 1000 psf

INBERG-MILLER ENGINEERS

CONSOLIDATION-SWELL TEST

ASTM D2435

Project:	Headquarters Final Geotech	Client:	Trona Valley FCU
Job No:	24624-GX	Test Date:	4/14/2025
Sample No:	B-11	Depth (ft):	2.5



Soil Description: Tan Clay with Sand

Liquid Limit (%):		
Plastic Limit (%):		
Plasticity Index (%):		

	Initial	Final
Moisture Content:	3.5%	14.5%
Saturation:	14%	138%
Wet Density (pcf):	105.7	150.3
Dry Density (pcf):	102.1	131.2

Specimen Diameter:	2.41	in.
Specimen Height:	1.00	in.
Overburden Pressure (Po):	264.2	psf
Preconsolidation Pressure (Pp):	1000	psf
Overconsolidation Ratio: (OCR = pp/po)	3.8	
Comp. Index (Cc):	0.179	
Consol. Index (Cr):	0.023	

Swell Pressure: psf

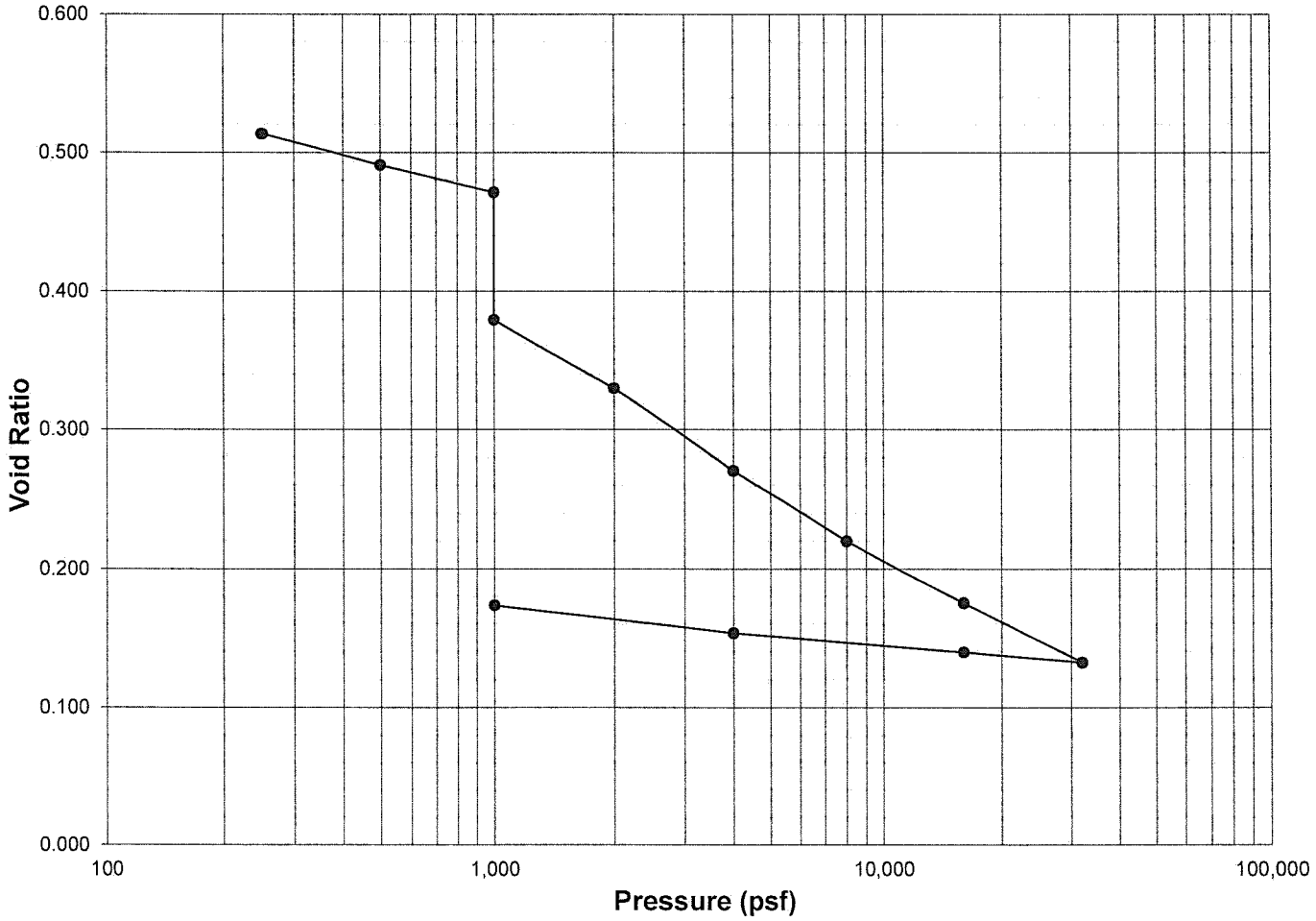
Percent Swell or Collapse*: -6.19% (- indicates collapse) Pressure when wetted: 1000 psf

INBERG-MILLER ENGINEERS

CONSOLIDATION-SWELL TEST

ASTM D2435

Project:	Headquarters Final Geotech	Client:	Trona Valley FCU
Job No:	24624-GX	Test Date:	4/12/2025
Sample No:	B-13	Depth (ft):	5



Soil Description: Gray Clay with Sand

Specimen Diameter:	2.41	in.
Specimen Height:	1.00	in.
Overburden Pressure (Po):	595	psf
Preconsolidation Pressure (Pp):	1000	psf
Overconsolidation Ratio: (OCR = pp/po)	1.7	

Liquid Limit (%):
Plastic Limit (%):
Plasticity Index (%):

	Initial	Final
Moisture Content:	6.8%	12.5%
Saturation:	36%	166%
Wet Density (pcf):	118.9	157.4
Dry Density (pcf):	111.3	139.9

Comp. Index (Cc):	0.146				
Consol. Index (Cr):	0.028				

Swell Pressure: psf

Percent Swell or Collapse*: -6.24% (- indicates collapse) Pressure when wetted: 1000 psf

INBERG-MILLER ENGINEERS

Appendix C

GLOSSARY

Definition of certain words, terms or phrases that are used in this report are provided below, to help the reader to interpret the intent of Inberg Miller Engineers. These definitions:

1. *May differ from other published versions*
2. *Have not been vetted by any organization outside of Inberg-Miller Engineers*
3. *May not present a complete understanding of the term*

The reader is encouraged to seek additional interpretation of important terms and consult with Inberg- Miller Engineers as necessary where discrepancies may be discovered, or a definition has not been provided.

Active Lateral Soil Pressure – Horizontal pressure applied by soil to a wall that sufficiently yields or rotates about its base to allow the full soil shear strength to be mobilized

Allowable End Bearing Pressure – Recommended maximum pressure on soil or rock expressed as load per unit area that can be applied across the full bottom bearing surface of a pier or pile deep foundation within a given settlement tolerance

Allowable Skin Friction – Recommended maximum frictional resistance of soil or rock as load per unit area that can be applied over the vertical side surface of a pier or pile deep foundation within a given settlement tolerance.

Alluvium – Soil that has been transported and deposited in a moving water environment

At-Rest Lateral Soil Pressure - Horizontal pressure applied by soil to a wall or the vertical face of a structure that is restrained from movement and soil is not allowed to deform

Backfill – Soil that is used to replace some or all of soil that was excavated, and is usually subject to material specifications and density requirements

Base – Either 1: the bottom surface of a structure or excavation, or 2: soil or aggregate that is placed immediately below a structure or pavement

Bearing Elevation – A subsurface level where the base of foundations rest and transmit applied load to the soil or rock

Bearing Stratum – A specific soil layer defined by soil description and depth below ground surface, or elevation, to which foundations transmit applied load

Claystone – Consolidated sedimentary bedrock comprised chiefly of clay sized particles

Collapse – Loss of inter-particle soil friction, usually as a result of the effects of excessive moisture or water, and often leading to large subsidence or settlement of supported structures

Colluvium – Soil that has accumulated as a result of gravitional transport, commonly found near the base of slopes

Compaction/Compacted – Process or the result of a process where soil density is increased, soil voids are decreased, and usually resulting in an increased strength and reduced settlement potential

Compressibility – Relative term applied to soil or soil layer to describe how much it may yield to expected applied load or pressure

Conglomerate – A mixture of clay through gravel-size particles, commonly cemented with calcium carbonate

Consistency – Term applied to cohesive soils to describe relative stiffness, often defined by either ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils or as indicated by unconfined compressive strength

Continuous Footing – A long narrow footing usually supporting a linear structure such as a wall. Length to width ratio may vary but is commonly taken as 10.

Contraction Joints – Formed or sawn joints in concrete slabs or pavements used to control crack patterns that result from thermal contraction or shrinkage

Crushed Aggregate Base – Processed gravel at a specified grading and quantity of fractured faces, and sometimes certain durability requirements, that is used below slabs or pavements

Cut – Term applied to the volume or depth of soil that has been excavated to a certain design grade

Cut Slope – Soil or rock slope that results from cut or excavation

Density – The weight of soil for a unit volume, which may be stated in a dry condition, or a moist to saturated condition with weight of water included

Dewatering – Process of removing water from an excavation or lowering the groundwater elevation usually via drains or pumps

Differential Settlement – The difference in subsidence of a soil surface, or structure resting on soil, between two points spaced a certain distance apart

Disturbed Soil – Soil that has been loosened usually as a result of excavation activity, traffic, vibration

Embedment – The portion of a structure buried within a specific stratum, usually measured as a vertical distance

Engineered Fill – Soil that meets a specific gradation criteria and/or other quality requirements and that is placed at a specified thickness and moisture content and compacted to meet certain minimum density requirements, for the purpose of consistently obtaining certain minimum engineering properties for design

Envelope A – Specified gradation criteria that describes reasonably well graded sand and gravel mixtures, with less than 20 percent silt and clay.

ESAL – Criteria that describes traffic loading equivalent to a certain number of passes from an 18 kip single axle

Excavation Subgrade – The bottom of an excavation

Expansion Joints – Joints that are formed in a concrete pavement or slab that allow for thermal expansion of the concrete. Joints are usually filled with an elastic material to prevent entry of foreign particles

Factor of Safety – A multiplier for recommended allowable values that provides a margin for safety against failure, considering uncertainty and risk

Fill – Soil or rock that has been placed to raise the ground surface elevation

Footing/Foundation Subgrade – The surface of soil or rock to receive a structure which is usually a reinforced cast-in-place concrete

Friction Angle – A measure of physical resistance against sliding between soil or rock particles, usually ranging between 0 and 45 degrees

Frost Heave – A phenomenon that occurs in certain soil types where soil-moisture may concentrate and freeze as ice layers, causing upward swelling of the soil

Frost Protection – Any measure used to prevent frost-heave from affecting a structure

Frost Susceptibility – Soil types that are prone to frost heave

Geotechnical Engineer – An engineer trained through education and experience in soil mechanics and earth-structure systems

Grade Beam – A horizontal structural element that spans between foundations which may carry a portion of load from a structure above, but usually doesn't rely upon support from the soil below

Heave – The upward swelling of soil or rock, usually as a result of freezing or moisture adsorption

Helical Screw Pile/Pier – A foundation type that consists of a steel shaft with steel helices welded to the shaft, so that the system will pull itself into the ground when torque is applied

Hydraulic Conductivity – The rate at which water passes through soil under a certain pressure, usually expressed in the units of centimeters per second

Hydrostatic Pressure – The hydraulic pressure at a certain depth below the surface of a water body or water in saturated soil equivalent to the weight of water multiplied by the depth

Isolated Pad Footing – A single footing for the support of a leg, column, stanchion or other vertical structural element

Lifts – Layers of material that are placed as fill, backfill or pavement

Mat Foundation – A large, shallow spread footing that may support any combination of multiple point or area loads

Maximum Allowable Bearing Pressure – The recommended maximum pressure that may be applied to soil or rock, including a factor of safety, within estimated settlement tolerances

Maximum Dry Density – The peak soil density that is determined in a laboratory using a drop-hammer and mold over a range of varying moisture contents, expressed in terms of dry weight per unit volume

Moisture Sensitivity – A characteristic of soil that describes how the strength or compressibility is affected by increasing moisture content

Moisture Vapor Control – A design measure to limit the upward movement of soil moisture, usually through a concrete floor slab resting on the soil

Native Soil – Soil that is present naturally at a subject site

On-Site Fill – Soil used as fill or backfill that originates from a source located at the subject site

Optimum Moisture Content – The moisture content at which the maximum dry density is achieved in laboratory testing

Organic Materials – Matter contained in soil that is subject to decomposition

Overburden – Soil or rock that is present above an ore body, sedimentary bedrock or certain deposit such as gravel

Overexcavation – A process by which usually unsuitable or unwanted soil or rock is removed or excavated below the bottom of a structure or minimum required excavation limits

Passive Lateral Soil Pressure – Available resisting soil pressure when a structure is forced against the soil

Pavement Subbase – A specified soil type, often described by gradation that is placed below base, which in turn supports flexible or rigid pavement

Perched Groundwater – A subsurface condition where water collects above a relatively low permeability stratum

Permeability – The rate at which a liquid or gas may pass through soil, rock or other material

Pile/Pier Cap – A reinforced concrete block designed to distribute load from a structure to multiple deep foundation elements

Proof-Rolling – A process by which a subgrade is subjected to wheel loading to locate relative soft or yielding areas that might be repaired before covering with structures, soil, pavement etc.

Raft Foundation – See Mat Foundation

Residual Soil – Soil that has resulted from the in-place weathering of rock

Rigid Pavement – Usually reinforced or unreinforced Portland cement concrete, which when cured exhibits high compressive strength but is relatively inflexible

Sandstone - Sedimentary bedrock comprised chiefly of sand sized particles

Saturation – A condition where the pores of soil or rock are completely filled with water

Sedimentary Bedrock – Consolidated sediments of clay, silt or sand

Shrink-Swell Potential – Likelihood that soil or rock may increase or decrease in volume, usually as result of water adsorption and indicated by high plasticity index and/or measured response to inundation

Siltstone - Sedimentary bedrock comprised chiefly of silt sized particles

Site Fill – Soil used to raise the grade of all or a portion of a site to a design elevation, exclusive of structures or buildings

Slab Fill – Soil used to fill above the foundation bearing elevation to the bottom of any special subbase or base soil/aggregate that supports a concrete slab-on-grade

Slab Subbase – Soil that meets a specified gradation requirement or other criteria for placement below a base aggregate

Spread Footing/Foundations – A foundation type that usually consists of a reinforced, cast-in-place concrete that is formed in a round, square, rectangle or continuous strip shape for transferring structural loads to the soil and is placed at certain minimum depths for frost protection or confinement

Stripping Depth – The depth below ground surface that unsatisfactory soil or other materials should be removed before placement of engineered fill or structures

Structural Fill – Soil that meets a specified gradation or other quality or strength criteria for the purpose of raising the ground surface elevation or improving bearing conditions to receive a structure

Subgrade – Soil surface or substrate that will receive pavement, structure, engineered fill, backfill etc.

Synthetic Reinforcement – Specially manufactured fabric, usually as a woven or extruded plastic, used for the purpose of forming a composite with soil or aggregate and adding strength

Synthetic Separation - Specially manufactured fabric, usually as a woven plastic or non-woven fibrous plastic, used for the purpose creating a barrier for the migration of fine-grained soil

Topsoil – Soil that contains organic matter, usually as decayed vegetation and roots, in sufficient quantity that it is compressible, moisture sensitive, or subject to settlement with continued decay

Total Settlement – An estimate of the amount of settlement that may occur over the life of a structure as a result of compression of underlying soil due to the pressure imposed by the structure

Transient Loading – Short term loads applied to a structure, such as from seismic force or wind pressure.

Ultimate Bearing Capacity – An estimate of the bearing pressure applied to a soil stratum that would induce shear failure, without consideration of a factor of safety or limiting settlement

Undisturbed Soil – Soil that is allowed to remain in its natural state without changing moisture content or density

Void Form – A concrete form material for casting a structure which provides support long enough for the concrete to complete curing and gain sufficient strength for the structure to support itself, leaving a void when the form disintegrates with weathering and moisture.

Water Table – The surface of groundwater within saturated soil or rock layers

Weathered Bedrock – Native rock formation that has become delaminated or shows evidence of disintegration as determined and defined by the geotechnical engineer to distinguish a certain stratum for the purposes of the report

GENERAL NOTES - LOG OF TEST BORING/TEST PIT

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction		Particle Size	U.S. Standard Sieve Size
Boulders		Larger than 12"	Larger than 12"
Cobbles		3" to 12"	3" to 12"
Gravel:	Coarse	3/4" to 3"	3/4" to 3"
	Fine	4.76mm to ¾"	#4 to ¾"
Sand:	Coarse	2.00mm to 4.76mm	#10 to #4
	Medium	0.42mm to 2.00mm	#40 to #10
	Fine	0.074mm to 0.42mm	#200 to #40
Silt		0.005mm to 0.074mm	Smaller than #200
Clay		Smaller than 0.005mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay

Relative Density		Consistency	
Term	"N" Value*	Term	q_u-tons/sq. ft.
Very Loose	0-4	Very Soft	0.0 to 0.25
Loose	4-10	Soft	0.25 to 0.5
Medium Dense	10-30	Firm	0.5 to 1.0
Dense	30-50	Stiff	1.0 to 2.0
Very Dense	Over 50	Very Stiff	2.0 to 4.0
		Hard	Over 4.0

*Note: The penetration number, N, is the summation of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140-pound weight falling 30", and is seated to a depth of 6" before commencing the standard penetration test.

DESCRIPTIVE ROCK CLASSIFICATION

Engineering Hardness Description of Rock

(not to be confused with MOH's scale for minerals)

Very Soft	Can be carved with a knife. Can be excavated readily with point of pick. Pieces one inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Medium Soft	Can be grooved or gouged 1/16-inch deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-inch-maximum size by hard blows of the point of a geologist's pick.
Medium Hard	Can be scratched with knife or pick. Gouges or grooves to ¼-inch deep. Can be excavated by hard blow of a geologist's pick. Hand specimens can be detached by moderate blow.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.

NOMENCLATURE

Drilling and Sampling

SS	--	Split Barrel (spoon) Sampler
N	--	Standard Penetration Test Number, blows/foot*
ST	--	Thin-walled Tube (Shelby Tube) Sampler
DC	--	Thick-wall, ring lined, drive sampler
C	--	Coring
DP	--	Direct Push Sampler
CS	--	Continuous Sampler (used in conjunction with hollow stem auger drilling)
D	--	Disturbed Sample (auger cuttings, air/wash rotary cuttings, backhoe, shovel, etc.)

Laboratory Tests

USCS	--	Unified Soil Classification System (soil type)
W	--	Water Content (%)
LL	--	Liquid Limit (%)
PL	--	Plastic Limit (%)
PI	--	Plasticity Index (LL-PL) (%)
qu	--	Unconfined Strength, TSF
qp	--	Penetrometer Reading (estimate of unconfined strength), TSF
γm	--	Moist Unit Weight, PCF
γd	--	Dry Unit Weight, PCF
WSS	--	Water Soluble Sulfate (%)
Φ	--	Angle of Internal Friction (degrees)
c	--	Soil Cohesion, TSF
SG	--	Specific gravity of soil solids
S	--	Degree of Saturation (%)
e	--	Void Ratio
n	--	Porosity
k	--	Permeability (cm/sec)

Water Level Measurement

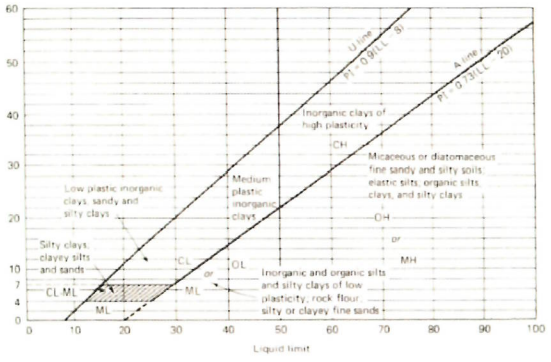
▼ -- Water Level at Time Shown

Note: Water level measurements shown on the boring logs represent conditions at the time indicated, and may not reflect static levels, especially in cohesive soils. The available water level information is given at the bottom of each log.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D2487-69 and D2488-69 (Unified Soil Classification System)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-Grained Soils (More than half of material is larger than No. 200 sieve size)	**Gravels** (More than half of coarse fraction is larger than No. 4 sieve size)	**Clean Gravels** (Little or no fines)	GW		Well graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 % GW, GP, SW, SP; More than 12% GM, GC, SM, SC	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(C_{30})^2}{D_{10} x D_{60}}$ between 1 & 3	
			GP		Poorly Graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels w/ Fines (Appreciable amount of fines)	GM[a]	d u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	**Clean Sands** (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 & 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands w/ Fines (Appreciable amount of fines)	SM[a]	d u	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained Soils (More than half material is smaller than No. 200 sieve size)	**Silts and Clays** (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	**Plasticity Chart**		
			CL		Inorganic clays of low to medium plasticity, gravelly, clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		P_t		Peat and other highly organic soils			



[a] Division of GM and SM groups into subdivision of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Important Information about Your

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical-Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical-engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical-engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold-prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your GBA-Member Geotechncial Engineer for Additional Assistance

Membership in the GEOPROFESSIONAL BUSINESS ASSOCIATION exposes geotechnical engineers to a wide array of risk confrontaton techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBA-member geotechnical engineer for more information.

GEOPROFESSIONAL BUSINESS ASSOCIATION
8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2014 by Geoprofessional Business Association, Inc.(GBA). Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document as a complement to or as an element of a geotechnical-engineering report. Any other firm, individual, or other entity that so uses this document without being a GBA member could be commiting negligent or intentional (fraudulent) misrepresentation.

INBERG-MILLER
ENGINEERS

CIVIL | GEOTECHNICAL | ENVIRONMENTAL | MATERIALS TESTING | SURVEYING | DRILLING

June 16, 2025

24624-GX

PDF REPORT EMAILED: mteuscher@tronavalley.com
THIS CONSTITUTES THE ORIGINAL

Ms. Moriah L. Teuscher
Trona Valley Community Federal Credit Union
840 Hitching Post Dr.
Green River, WY 82935

RE: PAVEMENT DESIGN ADDENDUM
TRONA VALLEY FEDERAL CREDIT UNION NEW HEADQUARTERS
SWEETWATER COUNTY, WY

Dear Ms. Teuscher:

This Report Addendum is intended to supplement our May 14, 2025 Subsurface Exploration and Geotechnical engineering report for the Trona Valley Federal Credit Union New Headquarters project.

If you have any questions or comments, please contact us at (307) 875-4394.

Sincerely,

INBERG-MILLER ENGINEERS

Professional Engineer
JOSEPH ILIYA
20615
Date 6/16/25
WYOMING

Joe Iliya, P.E.
Geotechnical Engineer

REVIEWED BY

Michael Brown, P.E.
Senior Vice President of Operations

JEI:bb\P:\24624-GX TRONA VALLEY FCU Headquarters Final Geotech Report\Geotech\24624-GX Pavement Design Report Addendum.docx

Table of Contents

1.1 GROUND IMPROVEMENTS 1
1.2 PAVEMENT 1

1.1 GROUND IMPROVEMENTS

Pavement

Location	Below Pavement Sections
Overexcavation Depth and Width	As needed to achieve pavement and road base grading depth.
Base Fill	WYDOT Grading W Base
Reconditioned Subgrade	8 inches for asphalt pavement, 12 inches for rigid pavement meeting 95% ASTM D 698
Fill Compaction	6-inch layers, 95% ASTM D 698
Geosynthetic Reinforcement	If soft or yielding subgrades are encountered

Geosynthetic reinforcement may be necessary if soft or yielding conditions develop during construction. The geotechnical engineer should be notified if these conditions develop to further refine recommendations for geosynthetic use.

1. Geosynthetic should be placed completely across the exposed excavation bottom and sides (if applicable), with sufficient overlap to allow for settlement and stretching. However, fabric should be placed in tension with as few wrinkles and folds as practical. We recommend a minimum of 2 feet overlap, or as recommended by the manufacturer.
2. Geosynthetic seams should be placed transverse to the trench or traffic direction as applicable.

1.2 PAVEMENT

Pavement Type	Parking and Drive Areas
Total ESAL	35,634
Asphalt Pavement	
Plant Mix Asphalt	4″
WYDOT Grading W Base	6″
Reconditioned Subgrade	8″
Rigid Pavement	
Portland Cement Concrete	8″
Reconditioned Subgrade	12″
Maximum Joint Interval	Per WYDOT Specifications

1. Asphalt Pavement materials should meet applicable requirements of Wyoming Department of Transportation, Specifications for Road and Bridge Construction, 2010 Edition, Section 401, 804, and 803.5. The asphalt concrete should be placed in maximum 3-inch-thick compacted lifts.
2. Tack coats conforming to Section 407 are recommended between lifts. Maximum size aggregate of 1/2 inch should be used for the upper lift. Either ½-inch or ¾-inch maximum size aggregate may be used for the lower lifts.

3. Reconditioned pavement subgrades should be scarified to a minimum depth of 8 inches, for Asphalt Pavement and 12 inches for Rigid Pavement, moisture conditioned, and compacted as described in Section 3.1. Prior to placing any aggregate base or pavement, the subgrade should be proof-rolled and any soft spots improved.

4. Portland cement concrete materials should meet the requirements of the Wyoming Department of Transportation, Specifications for Road and Bridge Construction, 2010 Edition. Four to 6 percent air entrainment is recommended for concrete exposed to weather and for concrete workability. Steel reinforcement is not required within the pavement; however, dowels should be provided across construction joints to transfer loads and resist pavement displacement. Dowels should have sufficient diameter and spacing to transfer vertical loads, while allowing horizontal movement due to expansion and contraction of the concrete pavement.

5. For unreinforced concrete pavement, joints should be placed so that slab panels are as square as possible. Contraction joints should have a maximum width of ¼ inch and be cut at least ¼ of the depth of the concrete. Contraction joints can be either tooled or saw cut. Expansion joints should be placed at the ends of the valley pans and between the pavement and curbs or walls. Expansion joints should have a minimum width of ½ inch. All contraction and expansion joints should be filled with a field molded sealant to prevent the infiltration of water into the underlying soils.

6. This report is not intended to provide sufficient information for detailing joints for complex pavements. Joint requirements are dependent on concrete materials and the geometry of the pavement. Joint details can be critical to the performance of a project and should be designed by knowledgeable professionals.

7. Provisions should be made to periodically observe the conditions of the pavements and perform maintenance on cracks and joints, as required. Observed drainage problems should be promptly remedied. A primary focus of the pavement maintenance plan is to prevent subgrade soils from becoming wet.

8. If bedrock is encountered, base can be placed directly on well-prepared bedrock.