ASU CREST CENTER

CAREER READINESS, EDUCATION, & SKILLS TRAINING

100% CONSTRUCTION DOCUMENT PROJECT MANUAL

MAY 18TH, 2026

SECTION 00 10 00 - TABLE OF CONTENTS

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS
- 00 09 00 - ENGINEERING INSPECTIONS AND OBSERVATIONS
- 00 10 02 - ENDANGERED SPECIES ACT COMPLIANCE
- 00 10 03 - STORMWATER POLLUTION PREVENTION PLAN
- 00 10 04 - ARKANSAS HISTORIC PRESERVATION PROGRAM REFERENCE

DIVISION 01 - GENERAL REQUIREMENTS
- 01 50 00 - TEMPORARY FACILITIES AND CONTROLS
- 01 57 13 - TEMPORARY EROSION AND SEDIMENT CONTROL
- 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS
- ASU-ITS – CAMPUS STANDARDS FOR REFERENCE

DIVISION 02 - EXISTING CONDITIONS
- NOT APPLICABLE

DIVISION 03 – CONCRETE
- NOT APPLICABLE

DIVISION 04 - MASONRY
- 04 20 00 - UNIT MASONRY
- 04 72 00 - CAST STONE MASONRY

DIVISION 05 - METALS
- 05 40 00 - COLD-FORMED METAL FRAMING
- 05 50 00 - METAL FABRICATIONS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES
- 06 10 00 - ROUGH CARPENTRY
- 06 41 16 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION
- 07 14 00 - FLUID APPLIED WATERPROOFING - DAMPPROOFING
- 07 21 00 - THERMAL INSULATION
- 07 21 63 - USER-FLUID APPLIED INSULATIVE COATING
- 07 24 00 - EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)
- 07 42 13 - METAL WALL AND ROOF PANELS
- 07 42 13.19 - INSULATED WALL PANELS
- 07 54 00 - THERMOPLASTIC MEMBRANCE ROOFING (TPO)
- 07 62 00 - SHEET METAL FLASHING AND TRIM
- 07 72 00 - ROOF ACCESSORIES

07 92 00 - JOINT SEALANTS

DIVISION 08 – OPENINGS

08 11 13 - HEAVY DUTY HOLLOW METAL DOORS AND FRAMES
08 33 23 - OVERHEAD DOORS
08 43 13 - ALUMINUM FRAMED ENTRANCES AND STOREFRONTS
08 44 13 - GLAZED ALUMINUM CURTAIN WALLS
08 71 00 - DOOR HARDWARE
08 80 00 - GLAZING
08 83 00 – MIRRORS

DIVISION 09 - FINISHES

09 29 00 - GYPSUM BOARD
09 30 13 - CERAMIC TILING
09 51 00 - ACOUSTICAL TILE CEILINGS
09 54 26 - SUSPENDED WOOD CEILINGS
09 65 13 - RESILIENT BASE AND ACCESSORIES
09 68 13 - TILE CARPETING

DIVISION 10 – SPECIALTIES

10 11 13 - MAGNETIC GLASS MARKERBOARDS
10 14 16 - PLAQUES
10 14 19 - DIMENSIONAL LETTER SIGNAGE
10 21 13 - TOILET PARTITIONS
10 22 26 - OPERABLE PARTITIONS
10 26 00 - WALL AND CORNER PROTECTION
10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES
10 44 16 - FIRE EXTINGUISHERS
10 51 13 - METAL LOCKERS

DIVISION 11 – EQUIPMENT

NOT APPLICABLE

DIVISION 12 – FURNISHINGS

12 24 13 - ROLLER WINDOW SHADES
12 25 13 - MOTORIZED ROLLER SHADES
12 36 61.16 - SOLID SURFACING SILLS & COUNTERTOPS

DIVISION 13 - SPECIAL CONSTRUCTION

NOT APPLICABLE

DIVISION 14 - CONVEYING EQUIPMENT

NOT APPLICABLE

DIVISION 21 - FIRE SUPPRESSION

21 00 00 - FIRE PROTECTION SPRINKLER SYSTEM
21 05 00 - FIRE PROTECTION COMMON WORK RESULTS
21 05 29 - FIRE PROTECTION SYSTEMS HANGERS-SUPPORTS
21 10 00 - WATER BASED FIRE SUPPRESSION SYSTEMS

DIVISION 22 – PLUMBING

22 00 00 - PLUMBING BASICS
22 00 15 - FIRESTOPPING AND SMOKE STOPPING
22 00 30 - ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT
22 00 75 - PLUMBING IDENTIFICATION
22 00 86 - PIPING INSULATION
22 00 90 - SUPPORTS HANGERS ANCHORS
22 01 10 - BASIC PLUMBING VALVES
22 01 20 - PIPING SPECIALTIES
22 01 40 - DOMESTIC WATER PIPING
22 01 50 - SANITARY WASTE AND VENT
22 01 55 - STORM DRAIN PIPING
22 01 60 - NATURAL GAS SYSTEM
22 05 00 - COMMON WORK RESULTS FOR PLUMBING
22 05 14 - PLUMBING SPECIALTIES
22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING COMPONENTS
22 11 13 - FACILITY WATER DISTRIBUTION PIPING
22 13 13 - FACILITY SANITARY SEWERS
22 15 00 - GENERAL SERVICE COMPRESSED AIR SYSTEMS

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

23 00 10 - MECHANICAL GENERAL
23 00 15 - FIRESTOPPING AND SMOKE STOPPING
23 00 30 - ELECTRICAL REQUIREMENTS FOR MECH EQUIP
23 00 60 - BASIC PIPING
23 00 75 - MECHANICAL IDENTIFICATION
23 00 86 - PIPING INSULATION
23 00 90 - SUPPORTS HANGERS ANCHORS
23 01 00 - SEISMIC RESTRAINT - SPECIFICATIONS, MECHANICAL
23 01 60 - MECHANICAL SYSTEMS INSULATION
23 01 84 - REFRIGERANT PIPING
23 07 05 - HIGH PRESSURE DUCTWORK
23 07 10 - HVAC SHEET METAL
23 08 95 - AIR TERMINAL DEVICES
23 09 90 - TESTING, ADJUSTING, AND BALANCING
23 90 00 - AUTOMATIC CONTROLS

DIVISION 25 - INTEGRATED AUTOMATION

NOT APPLICABLE

DIVISION 26 - ELECTRICAL

26 00 00 - ELECTRICAL GENERAL PROVISIONS
26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 48 - SEISMIC RESTRAINT FOR ELECTRICAL SYSTEMS
26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 73 - ARC-FLASH HAZARD ANALYSIS
26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS
26 24 13 - SWITCHBOARDS
26 24 16 - PANELBOARDS
26 27 26 - WIRING DEVICES
26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 51 19 - GENERAL LIGHTING

DIVISION 27 - COMMUNICATIONS

27 11 16 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES
27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 31 13 - ADDRESSABLE FIRE ALARM-VOICE EVAC SYSTEM

DIVISION 31 – EARTHWORK

31 10 00 - SITE CLEARING
31 20 00 - EARTH MOVING
31 21 16 - TRENCHING
31 23 19 - DEWATERING
31 50 00 - EXCAVATION SUPPORT AND PROTECTION

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 05 23 - CONCRETE FOR EXTERIOR IMPROVEMENTS
32 11 23 - AGGREGATE BASE COURSE
32 12 16 - ASPHALT PAVING
32 13 13 - CONCRETE PAVING
32 13 73 - CONCRETE PAVING JOINT SEALANTS
32 17 13 - PARKING BUMPERS
32 17 23 - PAVEMENT MARKINGS
32 17 26 - TACTILE WARNING SURFACING
32 31 19 - DECORATIVE METAL FENCES AND GATES
32 84 00 - LANDSCAPE IRRIGATION PERFORMANCE SPECIFICAITON
32 91 13 - SOIL PREPARATION
32 92 00 - TURF AND GRASSES
32 93 00 - PLANTS
32 94 00 - HYDROSEEDING

DIVISION 33 – UTILITIES

33 05 00 - COMMON WORK RESULTS FOR UTILITIES
33 05 13 - MANHOLES AND STRUCTURES
33 10 00 - SITE WATER DISTRIBUTION
33 11 00 - WATER SERVICE CONNECTIONS
33 12 00 - DISINFECTION OF WATER DISTRIBUTION
33 41 11 - STORM DRAINAGE

DIVISION 34 – TRANSPORTATION

NOT APPLICABLE

DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

NOT APPLICABLE

DIVISION 40 - PROCESS INTEGRATION

NOT APPLICABLE

DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT APPLICABLE

DIVISION 42 - PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

NOT APPLICABLE

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

NOT APPLICABLE

DIVISION 44 - POLLUTION CONTROL EQUIPMENT

NOT APPLICABLE

DIVISION 45 - INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT APPLICABLE

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

NOT APPLICABLE

DIVISION 48 - ELECTRICAL POWER GENERATION

NOT APPLICABLE

SECTION 000900 - ENGINEERING INSPECTIONS AND OBSERVATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Engage and provide a qualified Engineering Inspections and Observations firm to provide Owner and Engineer of Record daily Inspections and Observations and reports in addition to other inspections and observations required in other Specification Sections for the project. Frequency of Inspections and Observations shall be on an as-needed basis.

1. At a minimum the Inspections and Observations Engineer shall witness materials sampling and testing, City Inspections requiring an Owner Representative, and monthly Progress meetings.
2. Engineer of record may be retained at their standard hourly billing rate.
3. A third-party Engineer licensed in the State of Arkansas may be retained to provide the required daily Inspections and Observations.

B. Inspections and Observations Engineer shall report directly to the project Engineer of Record and the Owner.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 001002 - ENDANGERED SPECIES ACT COMPLIANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall comply with all requirements and recommendations of the United States Endangered Species Act and Gold and Bald Eagle Protection Act. All construction activity shall comply with the recommendations and requirements of the US Fish and Wildlife Service for the protection of endangered species. The following documents and codes are hereby incorporated by reference to these Project Specifications.

1. Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 et seq.)
2. Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d)

B. There are NOT known endangered species, or Bald or Golden Eagles present at or near the proposed work areas.

C. If endangered species or Bald or Golden Eagles are encountered during construction the Contractor shall stop work immediately and notify the Owner and Engineer. Contractor shall await direction prior to commencing work activities.

D. Contractor shall conduct a tree removal pre-construction conference to review the trees to be removed.

E. Contractor shall obtain written approval form the City, Owner, and Engineer prior to any burning of trees or brush onsite.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 001003 - STORMWATER POLLUTION PREVENTION PLAN

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall comply with all requirements and recommendations of the Arkansas Department of Energy and Environment (ADEE) Construction Stormwater Discharge Permit. The following documents and codes are hereby incorporated by reference to these Project Specifications.

1. Stormwater Pollution Prevention Plan (SWPPP) for Construction Activities for Large Construction Sites.
2. ADEQ SWPPP General Permit No. ARR150000 Large Site (AUTOMATIC COVERAGE for 5 Acres or More)

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 001004 - ARKANSAS HISTORIC PRESERVATION PROGRAM REFERENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall comply with all requirements and recommendations of the Arkansas Department of Heritage, Arkansas Historic Preservation Program and National Historic Preservation Act. The following documents and codes are hereby incorporated by reference to these Project Specifications.

1. National Historic Preservation Act of 1966 (NHPA, Public Law 89-665; 54 U.S.C. 300101 et seq.)

B. There are NOT known historic properties or cultural resources at or near the proposed work areas.

C. If cultural resources or historic properties are encountered during construction the Contractor shall stop work immediately and notify the Owner and Engineer. Contractor shall await direction prior to commencing work activities.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. |Contractor's use of site and premises.

1.2 PROJECT INFORMATION

A. Project Identification: ASU Career Readiness Education & Skills Training (CREST) .

1. Project Location: At the corner of Aggie Road and Longhorn Drive, Jonesboro Arkansas, 724050.

B. Owner: Arkansas State University, Jonesboro

C. Architect: Fennell Purifoy Architects 100 River Bluff Dr. Suite 320 Little Rock AR. 72202.

1. Architect's Representative: Phil Purifoy, AIA, 501-372-6735, phil@fennellpurifoy.com.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Architectural Consultant: Dake Wells Architecture.
   a. Architectural Consultant’s Representative: Andrew Wells, FAIA, 833-518-4545, awells@dake-wells.com.

E. Construction Manager: Clark Construction

1. Construction Manager Representative: Will Clark, 501-940-7558, willclark@clarkcontractors.net
2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Construction of the ASU CREST (Career Readiness Education and Skills Training) Building, adjacent parking lots with landscaping, and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a construction manager at risk with a guaranteed maximum.

1.4 PHASED CONSTRUCTION

A. The Work shall be conducted in multiple phases, with each phase substantially complete as indicated.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates all phases of the Work.

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, and Shop Drawings
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.

6. Repair or replace Owner-furnished products damaged following receipt.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations to equal or better condition

1.7 WORK RESTRICTIONS

A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than 14 days in advance of proposed utility interruptions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.2 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner and Engineer of Record reserve the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Contractor's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Construction Entrance

1. Unit of Measurement: Each (ea)

B. Unit Price No. 2 : Rock Check Dams

1. Unit of Measurement: Each (ea)

C. Unit Price No. 3: Silt Fencing

1. Unit of Measurement: Linear Feet (lf)

D. Unit Price No. 4: Gravel Removal

1. Unit of Measurement: Square Feet (sf)

E. Unit Price No. 5: Temporary Seeding for Erosion Control (Stabilization)

1. Unit of Measurement: Lump Sum (ls)

F. Unit Price No. 6: Tree Protection Fencing

1. Unit of Measurement: Linear Feet (lf)

G. Unit Price No. 7: Site Clearing - Tree & Grub Removal

1. Unit of Measurement: Square Feet (sf)

H. Unit Price No. 8: On-Site Earthwork Cut / Fill

1. Unit of Measurement: Cubic Yards (cy)

I. Unit Price No. 9: Import General Fill

1. Unit of Measurement: Cubic Yards (cy)

J. Unit Price No. 10: Export Cut

1. Unit of Measurement: Cubic Yards (cy)

K. Unit Price No. 11: Import Select Fill

1. Unit of Measurement: Cubic Yards (cy)

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
    b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

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

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.

f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit one digital signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. Copy shall include waivers of lien and similar attachments if required.

1. Transmit copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

G. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

H. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. Evidence that claims have been settled.
5. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. RFIs.
3. Project meetings.

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.3 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Owner name.
2. Owner's Project number.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms:

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.4 PROJECT MEETINGS

A. General: meetings and conferences at Project site unless otherwise indicated.

B. Preconstruction Conference: Contractor will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.4 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.5 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

2. Digital Shop Drawings: Digital copies of all submittals are preferred in PDF format.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualificatio Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.6 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.7 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

a. Actions taken by indication on Project management software website have the following meanings:

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

   1. Mockups are used for one or more of the following:

      a. Verify selections made under Sample submittals.
      b. Demonstrate aesthetic effects.
      c. Demonstrate the qualities of products and workmanship.
      d. Demonstrate successful installation of interfaces between components and systems.

e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 REPORTS AND DOCUMENTS

A. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

1.5 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Engage a qualified testing agency to perform quality-control services.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

MTA ENGINEERS

- Geotechnical Engineering
- Materials Testing • Special Inspections
- Design

mtaengineers.com

PRELIMINARY GEOTECHNICAL ENGINEERING EXPLORATION

ASU Crest Center
Jonesboro, AR

PREPARED FOR:

Mark Overturf, AIA
Director of Planning, Design and Construction
Moverturf@astate.edu
P.O. Box 250
State University, AR 72467

PREPARED BY:

MTA ENGINEERS
8001 National Drive
Little Rock, AR 72209

November 24, 2025

MTA ENGINEERS

Mark Overturf, AIA
Director of Planning, Design and Construction
Moverturf@astate.edu
P.O. Box 250
State University, AR 72467

November 24, 2025

Subject: Report of Geotechnical Engineering Exploration
Proposed ASU Crest Center
Jonesboro, Arkansas

Mr. Overturf:

MTA Engineers has completed the authorized Geotechnical Engineering Exploration for the above-referenced project. This work was conducted under the agreement between MTA Engineers and Arkansas State University, detailed in the MTA Engineers Proposal dated October 28th, 2025.

The purpose of our work was to review general surface and subsurface conditions within the project site area and to gather and present data relative to the design and construction of the proposed Windmill Rice Conveyor located in Jonesboro, AR. This report outlines the exploration procedures used, exhibits the data obtained, and presents our recommendations.

MTA Engineers appreciates this opportunity to provide these services and looks forward to working with you on future projects. Please contact us if you have any questions or require additional information.

Sincerely,

MTA ENGINEERS

Joseph Gray Spahn, PE
Project Engineer
Office +1 870-530-8380
grayspahn@mtaengineers.com

Spencer Baltz, EI
Staff Engineer
Office +1 870-530-8380
spencer@mtaengineers.com

TABLE OF CONTENTS

SECTION

EXECUTIVE SUMMARY 4

INTRODUCTION 6

FIELD EXPLORATION 6

GENERAL SITE AND SUBSURFACE CONDITIONS 7

LABORATORY TESTING 8

ANALYSIS & RECOMMENDATIONS 8

- SITE PREPARATION 8
- STRUCTURAL FILL 9
- BUILDING FOUNDATION 10
- FOUNDATIONS / SLAB 10
- PAVEMENT DESIGN 11
- UN-COMPACTED FILL 12
- STUMP/ ORGANIC FINDINGS 12
- SEISMIC CONSIDERATION 12
- CONSTRUCTION PROCEDURES 12

APPENDICES

APPENDIX A: Plan of Borings
APPENDIX B: Boring Logs
APPENDIX C: Key to Terms and Symbols
APPENDIX D: Laboratory Test Summary
APPENDIX E: Seismic Design Criteria

TABLES

1	Soil Types Encountered in Borings	4
2	General Strata Classification of Boring Logs	7
3	Pavement Design Assumption Values	12
4	Pavement Design Recommendations	13

EXECUTIVE SUMMARY

The geotechnical exploration was conducted at the property in the southeast corner of the Red Wolf Blvd and Aggie Rd intersection. The general topography of the site was flat, with the area consisting of light vegetation and farmland. In general, the soils will consist of silty clay, clayey silt/silt, lean clay, and clayey sand/silty sand. Subsurface conditions were generally consistent throughout the proposed development.

Major soil types encountered at each boring may be summarized as follows:

Table 1: Soil Types Encountered

SOIL TYPE	DESCRIPTION
CL-ML	Silty Clay
ML	Clayey Silt/Silt
CL	Lean Clay
SC/SM	Clayey/Silty Sand

See Table 2 General Strata Classification of Boring Logs or the individual boring logs found in Appendix B for a more detailed overview of the soils encountered on site.

Soft, moisture-sensitive soils were encountered at the top two (2) feet at most boring locations. A **2-ft** minimum undercut may be required depending on the results of the initial site proof roll and final elevations.

Possible suitable fill CL soils were found from **2 to 18-ft** in boring **B1**, however these soils contained high moisture levels at the time of our exploration and will need to be moisture conditioned before use for fill in any building pad or pavement areas.

If the proposed structure is founded at or near existing grades then an over excavation of at least **2-ft** is anticipated. Raising of grades in the order of **5-ft** will likely be required to eliminate the need for undercut depending on the site conditions at the time of construction.

Traditional shallow footings founded per this report (see Shallow Foundations section), within structural fill placed per the structural fill section of this report may be sized using a net allowable end bearing pressure of **2,000-psf** for continuous and **2,500-psf** for individual spread footings. The net allowable end bearing pressure is based on a factor of safety of 3.0 with respect to the anticipated shear strength of the bearing stratum. Total and differential settlement is anticipated to be less than ½-in.

SUMMARY

- **Rock/Hard Dig:**
  - Excavation may be performed using medium-duty equipment.
  - No rock/hard dig was encountered during the exploration.
- **Soils:**
  - Surface soils generally consist of soft silts and clays.
  - Stripping in the order of at least 6-in to remove surface organics.
  - Soft, moisture-sensitive soils found at construction depth. Undercut should be anticipated at paving and/or footing locations depending on final elevations.
- **Foundations/Slabs:**
  - Shallow foundations founded per this report may be sized using a bearing pressure of 2,000-psf for continuous and 2,500-psf for individual spread footings.
  - Undercut may be required depending on the initial proof roll results. Undercut amount will depend on final elevations.
- **Un-compacted Fill:**
  - No un-compacted fill was encountered on the property during the exploration.
- **Pavement:**
  - Recommended pavement sections are presented within this report.
  - Subgrade should consist of structural fill or stabilized in-situ soils.
  - Chemical Stabilization can mitigate soft unstable soils for paving. Paving cross sections can possibly be reduced to provide cost savings if soil stabilization is utilized.
- **Stump/Organic Findings:**
  - The proposed improvement area is covered with light vegetation, with cow pasture on the north and west sides and farmland in the central and south areas. The potential to find stumps or other organic material below the surface is low.
- **Miscellaneous:**
  - Groundwater was encountered at most boring locations at approximately 18-19’ below the existing surface.
  - Potential exists for increased soil instability due to precipitation events during construction. Increased moisture may require additional undercut.

INTRODUCTION

This exploration was requested to evaluate existing subsurface conditions and provide geotechnical design recommendations. The results of this exploration and the geotechnical design recommendations for site construction are presented in this report.

Exploration was accomplished by:

1. Excavating 7 locations to a maximum depth of 20-ft, or refusal, to explore subsurface soil and groundwater conditions.
2. Obtaining samples from each stratum, within the accessible areas, using standard geotechnical sampling technique or standard penetration test.
3. Performing laboratory tests on various samples to determine pertinent engineering properties of the subsurface strata.
4. Analyzing field and laboratory test data to develop design recommendations.

The scope of this geotechnical exploration did not include an environmental assessment to determine the presence of wetlands and/ or hazardous or toxic materials in the soil or groundwater on or near this site. If there is concern of wetlands or a hazardous/ toxic material presence, a qualified environmental assessment consultant should be contacted to perform a site investigation before construction begins.

FIELD EXPLORATION

Subsurface conditions at the site were explored by using dry auger methods and a split spoon sampler with a TMG CSR-174 drill rig to drill borings to a maximum depth of 20-ft at 7 boring locations. The approximate boring locations are shown on the Plan of Borings (see Appendix A). Boring logs presenting descriptions of the soil strata encountered are included in Appendix B. Laboratory testing summary of the different soil types are included in Appendix D.

Samples were obtained throughout all locations in general accordance with Standard Penetration Sampling (SPT). The recorded N-Values (blows per foot) are indicated on the Boring Logs in the

"Blows per Foot" column. All soil samples encountered were removed from the field in moisture-tight containers and transported to our laboratory for further examination. At the lab, a visual classification was performed for each sample. All various soil types were then analyzed for specific engineering properties. The dry auger drilling procedures facilitated the observation of shallow groundwater conditions.

GENERAL SITE AND SUBSURFACE CONDITIONS

The exploration was conducted on the property from the southeast corner of Red Wolf Blvd and Aggie Road to the southwest corner of Aggie Road and Longhorn Road and extended south to the end of the farm plots. The area of exploration was generally flat with grass and farmland covering the area. The stratigraphy encountered in the boring locations is summarized in Table 2. Subsurface conditions were generally consistent throughout the explored property. For a more detailed description of soils encountered while testing, see the boring logs found in Appendix B.

Table 2: General Strata Classification of Boring Logs

STRATA	DEPTH (ft)	SOIL CLASSIFICATION	SOIL DESCRIPTION	SIGNIFICANT PROPERTIES
STRATUM Ia	0 – 20	ML	Clayey Silt/Silt	Soft to Very Stiff **Highly Moisture Sensitive**
STRATUM Ib	2 – 20	CL-ML	Silty Clay	Very Soft to Very Stiff Moisture Sensitive
STRATUM II	6 – 18.5	CL	Lean Clay	Firm to Stiff
STRATUM III	13.5 – 20	SC/SM	Clayey Sand/Silty Sand	Medium Dense

The significant properties and characteristics of the subsurface strata pertinent to design and construction are as follows:

A. Final design elevations.
B. The anticipated bearing loads.
C. Soft, moisture-sensitive soils found at top two (2) feet.

LABORATORY TESTING

Descriptions of the soils encountered in the sample locations were prepared in general accordance with applicable ASTM standards. The soil stratification shown on the Boring Log Reports represents soil conditions at specific sample locations. There may be some variations that occur between or beyond the sample locations.

The stratification lines on the boring logs represent the approximate boundaries between soil types, but the actual transitions between soil layers in the subsurface of the proposed site may be gradual. Laboratory testing was performed to verify/evaluate classification, volumetric stability, and to determine water content. The results of all testing performed are represented in Appendix D Laboratory Test Summary.

ANALYSIS AND RECOMMENDATIONS

SITE PREPARATION

Site should be stripped/ grubbed 6-in to remove all organics. All stripped areas should be scarified, moisture conditioned and recompacted to a minimum of 95% of the materials modified proctor (ASTM D-1557). In areas where undercut is required this can be done simultaneously. Soft soils were encountered in the top two (2) feet at most boring locations. A two (2) foot minimum undercut may be required depending on the results of the initial site proof roll. It is recommended that shallow foundations are placed on a minimum of **2-ft** of approved structural fill. This can be achieved through over excavation, raising of final grades or a combination of both. Further information regarding foundations can be found in the “Building Foundations” section of this report. Final elevations and onsite conditions at the time of construction will determine the amount of undercut required.

Areas of proposed building and paving should be “proof rolled” using a 62,000lb equivalent load before the addition of any fill. Proof roll should be observed a representative of MTA Engineers to determine any areas of instability. Any instability should be assessed by the soils engineer and means of mitigation determined to include over-excavation and backfill using structural fill. Areas of instability will greatly depend on the condition of the soil at the time of construction. Onsite soils are

highly moisture sensitive. Increased soil moisture will result in greater areas of instability. Excavation should be performed under dry conditions, using equipment adequate to perform the work. Medium construction equipment should be adequate to perform work needed. Positive drainage must be maintained during construction to prevent inundation. Backfill and fill should be placed in accordance with the Structural Fill section of this report.

The building pads should be constructed above the existing grade to provide positive drainage. Some over-excavation of footings could be required depending on the soil moisture condition at the time of excavation. Soil-bearing information given in the building foundations section of this report will be based on these site preparation conditions.

Areas of proposed pavement will likely require over excavation or chemical stabilization depending on final grades. Chemical stabilization (cement) will likely improve the constructability of this project, including areas of pavement. MTA can provide project specific recommendations for stabilization when more information is known about final grades, pavement sections, and traffic loading. For rough estimation purposes, an application rate of 6% by dry weight of soil (estimated dry weight of 105 $^{lbs}/_{ft3}$ if onsite materials are used), to a depth of 1-ft, can be used.

STRUCTURAL FILL

Select fill, where needed, should consist of approved materials, which are free of organic matter and debris. For approval, samples of the proposed fill material should be submitted to MTA Engineers for classification testing. Select fill consisting of low plasticity soil such as lean clay or clayey gravel classifying as SC, CL, or GC according to the Unified Soils Classification System are generally considered suitable. High-plasticity clay soils (soils with a Liquid Limit above 50) should not be used as fill. Rock fragments that are greater than four (4”) inches for the building or six (6”) inches for the parking and drive areas should not be included in engineered fill. Select fill should have a Plasticity Index between ten (10) and twenty-five (25) and a Liquid Limit no greater than fifty (50).

Placement of approved fill should be achieved in multiple thin lights. Each lift should not exceed eight **8-in** in loose thickness. Compaction of these lifts should be performed with suitable equipment to achieve **95%** of a modified proctor (ASTM D-1557) at **2% below to 3% above** of optimum moisture content depending on the type of material used for fill. Thinner lifts may be required based on the

compaction equipment being used. Care should be taken that all compaction recommendations are performed.

If cohesive soils are to be used, compaction should be performed using a kneading-type vibratory compactor, such as a vibratory sheepsfoot. The material should be broken down sufficiently to provide a dense matrix of particles. Fragments should be no larger than four (4") inches under the building pads and roadways.

BUILDING FOUNDATIONS

All foundations must satisfy two basic and independent design criteria. First, foundations must have an acceptable factor of safety against bearing failure under maximum design loads. Secondly, movement of the foundation due to consolidation, shrinkage, and/or swelling of the supporting strata should not exceed tolerable limits for the structure. Construction factors such as installation of foundation units, excavation procedures, and surface and groundwater conditions should also be considered.

These factors and the aforementioned subsurface conditions were influential in development of the following statement. Given the anticipated foundation loading and subsurface conditions encountered, it is suggested that the proposed structures be supported on a foundation system designed in accordance with the following recommendations.

FOUNDATIONS/ SLABS

Shallow Foundations

Based on the nature of existing soils encountered at the time of exploration and the anticipated loading, the proposed structure can be supported on traditional shallow footings founded on a minimum of 2-ft of structural fill, placed and compacted per the "Structural Fill" section of this report, and founded a minimum of 24-in beneath final exterior grade. In addition, to minimize the potential for localized shear failure within the soils, a minimum footing width of 24-in is recommended.

Shallow foundations founded as accounted may be designed using a net allowable bearing pressure of 2,000-psf for continuous and 2,500-psf for individual spread footings if founded in moisture conditioned, properly compacted structural fill placed per this report. The net allowable end-bearing pressures will be based on a factor of safety in excess of 3.0. Total and differential settlement is anticipated to be less than ½-in.

Slab-on-grade type construction is considered appropriate for the floor slab. We recommend that the slab be supported on 4-in of clean crushed stone or gravel (ASTM C-33 #57 or equivalent) on prepared subgrade. A Class A impervious moisture barrier with a minimum thickness of 10-mils, specified according to ASTM E-1745, should be provided between the slab and the granular fill due to the potential for perched water to develop during the wetter seasons.

Subgrade soils under the slab and within footings should be evaluated by the geotechnical engineers from MTA Engineers to verify proper bearing.

PAVEMENT DESIGN

Paved parking and drives will be constructed as part of the project. Design traffic volumes and loadings have not been determined. However, we anticipate that the asphalt drives will be subject to light vehicles and weekly service trucks. We anticipate that the drives will be placed at/or above the existing elevation.

Areas of proposed pavement should be prepared in accordance with the “Site Preparation” of this report. MTA anticipates a minimum of 2-ft undercut in areas of pavement, or chemical stabilization of in-situ soils depending on the final elevations.

The following design criteria were used to develop the recommended pavement sections in conjunction with the AASHTO Design Guide 1996:

Table 3. Pavement Design Assumption Values

PAVEMENT DESIGN ASSUMPTION VALUES	
CBR	5
R-VALUE	15
SOIL SUPPORT VALUE (S)	5

Based on information obtained during this study, subgrade soils in the paved areas should generally consist of moisture conditioned, properly compacted structural fill or stabilized soils. Fill, where required, should be placed as recommended in the Structural Fill section of the report.

As previously stated, any organic containing soil should be stripped off in the order of **6-in**. It is recommended that positive site drainage should be provided during construction and be incorporated during the final design.

Table 4. Pavement Design Recommendations

PAVEMENT DESIGN RECOMMENDATIONS	
Standard Duty Asphalt Paving	3-in ACHM Surface Course
	8-in Crushed Stone Base Course
	24-in Approved Subgrade
Heavy Duty Asphalt Paving	4-in ACHM Surface Course
	8-in Crushed Stone Base Course
	24-in Approved Subgrade
Standard Duty Concrete Paving	5-in Concrete Pavement
	6-in Crushed Stone Base Course
	24-in Approved Subgrade
Heavy Duty Concrete Paving and Dumpster Pad	6-in Concrete Pavement
	8-in Crushed Stone Base Course
	24-in Approved Subgrade

Notes:
It should be recognized that some periodic maintenance of pavement will be required. As a minimum, this should include periodic sealing of all joints and cracks to prevent surface water infiltration.

If soil stabilization is utilized there is a possibility of reducing the base course and pavement layers that may provide a cost savings. When more information is known about loading conditions and final elevations, a more specific analysis of pavement sections can be conducted.

UN-COMPACTED FILL

No uncompacted fill was encountered on the property during exploration.

STUMP/ ORGANIC FINDINGS

The proposed improvement area is covered with light vegetation. The potential to find stumps or other organic material below the surface is low.

SEISMIC CONSIDERATION

Based on ASCE/SEI 7-16, a site soil **Class D** may be used for design purposes. Liquefaction potential of the soils in Stratum Ia, Ib, II, & III is negligible. Additional design information on Seismic Consideration is attached as Appendix E.

CONSTRUCTION PROCEDURES

The potential exists for increased groundwater to develop during wetter seasons. Therefore, foundation excavation and any other site grading should be performed during drier periods to reduce the possibility of changes in conditions.

Care should be taken to provide positive drainage during and after construction. All roof run-off should be collected in gutter systems. Down spouts should direct water a minimum of 5-ft from the building before discharge. Deep rooted landscape should not be placed within 5-ft of the building foundations.

Subsurface conditions significantly at variance with those encountered within the borings should be brought to the attention of the engineer, and work delayed pending evaluation and/or preparation of additional recommendations, if warranted.

Soil stabilization may increase all weather constructability on this site. MTA Engineers can provide recommendations and/or procedures for soil stabilization upon receipt of additional project information.

♦ ♦ ♦ ♦

The following illustrations are attached and complete this report:

Appendix A: Plan of Borings

Appendix B: Boring Logs

Appendix C: Key to Terms and Symbols

Appendix D: Laboratory Test Summary

Appendix E: Seismic Design Criteria

♦ ♦ ♦ ♦

Appendix A : Plan of Borings

1 OF 1 DRAWING NO:	ARKANSAS STATE UNIVERSITY	**West Farm** **Aerial View with Campus Map Overlay**	DWN. DATE PAC 10/23/2025 REV. DATE SCALE: 1:100

Appendix B: Boring Logs

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B1
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			SOFT, GRAYISH BROWN SILTY CLAY WITH TOPSOIL, DRY	CL-ML						2 2-2	4
					21	16.5	33	12	94.0	2 4-4	8
5										4 5-10	15
						21.3			81.7	3 7-12	19
										4 6-8	14
10			SOFT TO STIFF, GRAYISH BROWN LEAN CLAY, DRY	CL							
15										3 2-3	5
20			MEDIUM DENSE, RED CLAYEY SAND, DRY	SC						4 4-6	10
			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, COW PASTURE

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B2
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			SOFT, BROWN SILTY CLAY WITH TOPSOIL, DRY	CL-ML						2 2-2	4
										3 4-5	9
5			FIRM, BROWNISH GRAY SILT, DRY	ML						4 6-8	14
										4 6-7	13
										4 3-5	8
10											
			FIRM TO STIFF, GRAYISH BROWN LEAN CLAY, MOIST @ 8'	CL							
15										3 4-5	9
20										1 1-1	2
			VERY SOFT, LIGHT BROWN SILTY CLAY, WET @ 18.5'	CL-ML							
25										1 WOH-2	2
			Boring Terminated								
30											

COMPLETION DEPTH: 25 WATER DEPTH> INITIAL: 18.5' AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, NW OF GOAT PEN

P.O. Box 23715 • Little Rock, AR 72221
Ph. 501.753.2526 • Fax 501.753.5747

505 Sanders Ave. • Springdale, AR 72764
Ph. 479.756.0061 • Fax 479.756.9254

101 S. Church St. • Jonesboro, AR 72401
Ph. 870.530.8380 • Fax 870.972.0237

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B3
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			SOFT TO STIFF, BROWN SILTY CLAY, DRY *OLD CONCRETE FOUND @ APPROX. 3-4'*	CL-ML						1 2-2	4
										5 4-4	8
5					NP	18.2	30		91.1	5 10-10	20
										4 5-6	11
			FIRM TO STIFF, GRAYISH BROWN TO REDDISH GRAY CLAYEY SILT, DRY	ML						3 4-6	10
10											
15			LOOSE, TAN SAND WITH SILT, MOIST	SM	NP	9.6	NV		17.2	2 4-6	10
20			SOFT, TANNISH GRAY SANDY SILT, WET	ML						1 2-2	4
			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: 18' AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, SE CORNER OF W SIDE POND

P.O. Box 23715 • Little Rock, AR 72221
Ph. 501.753.2526 • Fax 501.753.5747

505 Sanders Ave. • Springdale, AR 72764
Ph. 479.756.0061 • Fax 479.756.9254

101 S. Church St. • Jonesboro, AR 72401
Ph. 870.530.8380 • Fax 870.972.0237

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B4
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			SOFT TO VERY STIFF, BROWN TO GRAY BROWN SILTY CLAY, DRY	CL-ML						2 2-1 2 1-4	3 5
5			WHITE/BROWN TO GRAYISH BROWN SANDY SILT WITH ORGANICS	ML	22	19.6	24	2	68.9	6 12-11 3 7-6	23 13
10			FIRM, BROWNISH RED LEAN CLAY, DRY	CL						3 3-5	8
15			STIFF TO SOFT, REDDISH GRAY SANDY SILT, WET @ 18.5'	ML						4 9-8	17
20										1 1-2	3
			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: 18.5' AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, MIDDLE OF W SIDE OF SITE

P.O. Box 23715 • Little Rock, AR 72221
Ph. 501.753.2526 • Fax 501.753.5747

505 Sanders Ave. • Springdale, AR 72764
Ph. 479.756.0061 • Fax 479.756.9254

101 S. Church St. • Jonesboro, AR 72401
Ph. 870.530.8380 • Fax 870.972.0237

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B5
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			SOFT, GRAYISH BROWN SILTY CLAY, DRY	CL-ML						2 2-2	4
					NP	15.0	26		87.2	5 12-16	28
5										3 3-3	6
										2 3-4	7
			VERY STIFF TO FIRM, GRAY TO GRAYISH BROWN SILT, DRY	ML	26	17.6	35	9	88.4	3 4-7	11
10											
										3 2-4	6
15			FIRM, TANNISH BROWN SANDY CLAY, MOIST	CL							
			VERY SOFT, BROWNISH GRAY CLAYEY SILT, WET	ML						WOH 1-2	3
20			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: 19' AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, E-SE AREA OF SITE

P.O. Box 23715 • Little Rock, AR 72221
Ph. 501.753.2526 • Fax 501.753.5747

505 Sanders Ave. • Springdale, AR 72764
Ph. 479.756.0061 • Fax 479.756.9254

101 S. Church St. • Jonesboro, AR 72401
Ph. 870.530.8380 • Fax 870.972.0237

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B6
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
										2 2-4	6
					20	20.8	27	7	98.0	6 4-3	7
5										4 2-3	5
										2 4-5	9
					19	22.1	26	7	92.1	3 4-6	10
10			SOFT TO STIFF, GRAYISH BROWN SILTY CLAY, WET @ 18.5'	CL-ML							
										4 6-7	13
15											
20										2 3-4	7
			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: 18.5' AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, SW CORNER OF SITE

P.O. Box 23715 • Little Rock, AR 72221
Ph. 501.753.2526 • Fax 501.753.5747

505 Sanders Ave. • Springdale, AR 72764
Ph. 479.756.0061 • Fax 479.756.9254

101 S. Church St. • Jonesboro, AR 72401
Ph. 870.530.8380 • Fax 870.972.0237

MTA ENGINEERS a division of
MATERIALS TESTING OF ARKANSAS
www.mtaengineers.com

Boring Log Report

BORING NO. B7
PAGE 1 OF 1

JOB NO. GEO25-217
JOB NAME: ASU CREST CENTER
COORDINATES: NORTH: _____ EAST: _____
STATION: _____
LOCATION: JONESBORO, AR

DATE: 11-4-25
TYPE OF DRILLING: HOLLOW STEM
EQUIPMENT: TMG CSR-174
LOGGED BY: SPENCER
DRILLED BY: PHILLIP

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			VERY SOFT TO FIRM, GRAYISH BROWN SILTY CLAY, MOIST	CL-ML						1 1-1	2
										2 3-4	7
5			STIFF TO FIRM, BROWNISH GRAY SILT, MOIST	ML		22.5			90.6	3 6-7	13
										2 3-4	7
10			FIRM TO SOFT, GRAYISH BROWN SILTY CLAY, MOIST, WET @ 14'	CL-ML						2 3-4	7
15										2 2-2	4
20										2 1-3	4
25			Boring Terminated								
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: AFTER 24 HOURS:

REMARKS: 6" ORGANICS AT SURFACE, SE CORNER OF SITE ON FARM PLOT

Appendix C: Key to Terms and Symbols

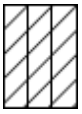
MTA ENGINEERS a division of Materials Testing of Arkansas, Inc.

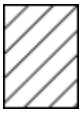
P.O. Box 23715 • Little Rock, AR 72221 Ph. 501.753.2526
P.O. Box 688 • Springdale, AR 72765 Ph. 479.756.0061
101 S. Church Street, Box 4 • Jonesboro, AR 72401 Ph. 870.530.8380

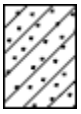
TERMS AND SYMBOLS USED ON BORING LOGS

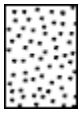
SOIL TYPES

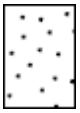
CLAY (CH)

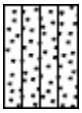

SILTY CLAY (CL)


CLAY (CL)

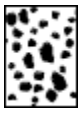

SANDY CLAY (CL)

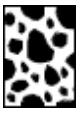

WELL-GRADED SAND (SW)

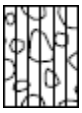

POORLY-GRADED SAND (SP)


SILTY SAND (SM)

CLAYEY SAND (SC)

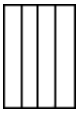

WELL-GRADED GRAVEL (GW)

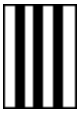

POORLY-GRADED GRAVEL (GP)

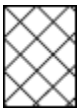

SILTY GRAVEL (GM)

SANDY SILT (ML)

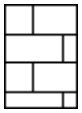
CLAYEY GRAVEL (GC)


SILT (ML)

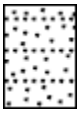

SILT (MH)

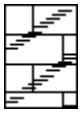

FILL MATERIAL

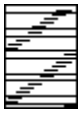
ROCK TYPES

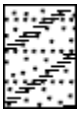

LIMESTONE

SHALE


SANDSTONE

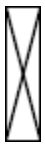

WEATHERED LIMESTONE


WEATHERED SHALE


WEATHERED SANDSTONE

SAMPLER TYPE

SHELBY TUBE SAMPLE


SPLIT SPOON SAMPLE

AUGER SAMPLE

NO RECOVERY

MTA ENGINEERS a division of Materials Testing of Arkansas, Inc.

P.O. Box 23715 • Little Rock, AR 72221 Ph. 501.753.2526
P.O. Box 688 • Springdale, AR 72765 Ph. 479.756.0061
101 S. Church Street, Box 4 • Jonesboro, AR 72401 Ph. 870.530.8380

SOIL GRAIN SIZE

U.S. STANDARD SIEVE								
12"	3"	3/4"	4	10	40	200		
BOULDERS	**COBBLES**	**GRAVEL**		**SAND**			**SILT**	**CLAY**
		COARSE	**FINE**	**COARSE**	**MEDIUM**	**FINE**		
304	76.2	19.1	4.75	2	0.42	0.074	0.002	
SOIL GRAIN SIZE IN MILIMETERS								

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No 200 sieve): Includes (1) clean gravels and sands, and (2) silty clayey gravels and sands condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERMS	N VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0 – 15 %
LOOSE	4-10	15 – 35 %
MEDIUM DENSE	10-30	35 – 65 %
DENSE	30-50	65 – 85 %
VERY DENSE	50 and above	85 – 100 %

FINE GRAINED SOILS (major portion passing No 200 sieve): include (1) inorganic and organic silt and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer reading or by unconfined compression tests.

DESCRIPTIVE TERMS	N VALUE	UNCONFINED COMPRESSIVE STRENGTH TON / SQ. FT.
VERY SOFT	0-3	less than 0.25
SOFT	3-6	0.25 - 0.50
FIRM	6-12	0.50 - 1.00
STIFF	13-20	1.00 - 2.00
VERY STIFF	20-50	2.00- 4.00
HARD	50 and above	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency rating of such soils are based on penetrometer readings

TERMS CHARACTERIZING MOISTURE CONTENT

DRY: No water evident in sample; fines less than plastic limit.
MOIST: Sample feels damp; fines near the plastic limit.
VERY MOIST: Water visible on sample; fines greater than plastic limit and less than liquid limit.
WET: Sample bears free water; fines greater than liquid limit.

TERMS CHARACTERIZING SOIL STRUCTURE

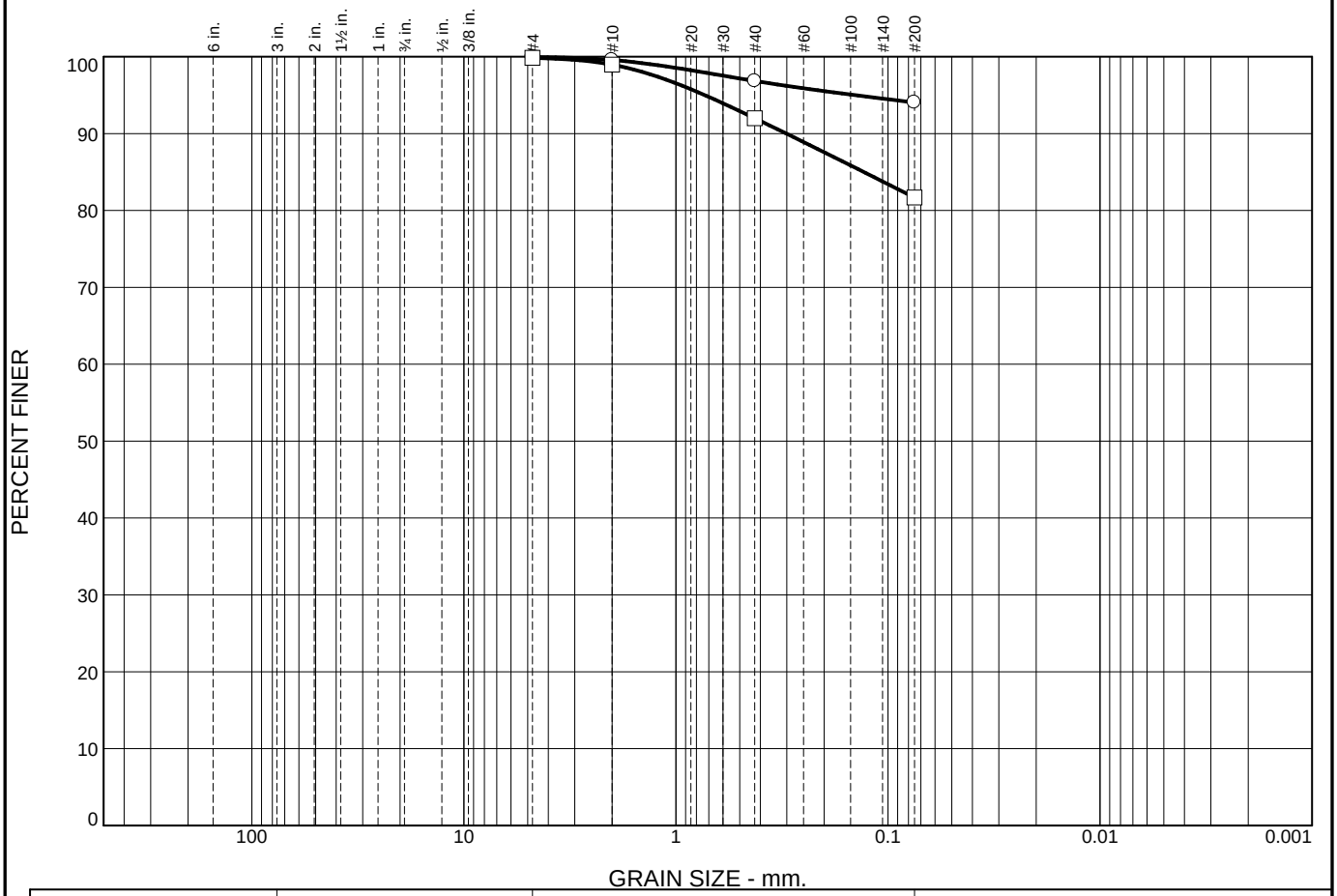
SLICKENSIDED: Having inclined planes of weakness that are slick and glassy in appearance.
FISSURED: Containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED: Composed of thin layer of varying color and texture.
INTERBEDDED: Composed of alternate layers of different soil types
CALCAREOUS: Containing appreciable quantities of calcium carbonate.
WELL GRADED: Having wide range in grain sizes and substantial amounts of all intermediate particle size.
POORLY GRADED: Predominantly of one grain size, or having a range of sizes with some intermediate size missing

---

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with UNIFIED SOIL CLASSIFICATION SYSTEM as described in technical Memorandum No 3-357, Waterways Experiment Station, March 1953

Appendix D: Laboratory Test Summary

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.4	2.8	2.8	94.0	
□				0.9	7.0	10.3	81.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	33	21								
□			0.1300							

Material Description	USCS	AASHTO
○ SOFT TO STIFF, GRAYISH BROWN LEAN CLAY, DRY	CL	A-6(11)
□		

Project No. GEO25-217 **Client:**
Project: ASU CREST CENTER

○ **Source of Sample:** B1 **Depth:** 2 **Sample Number:** S2
□ **Source of Sample:** B1 **Depth:** 6 **Sample Number:** S4

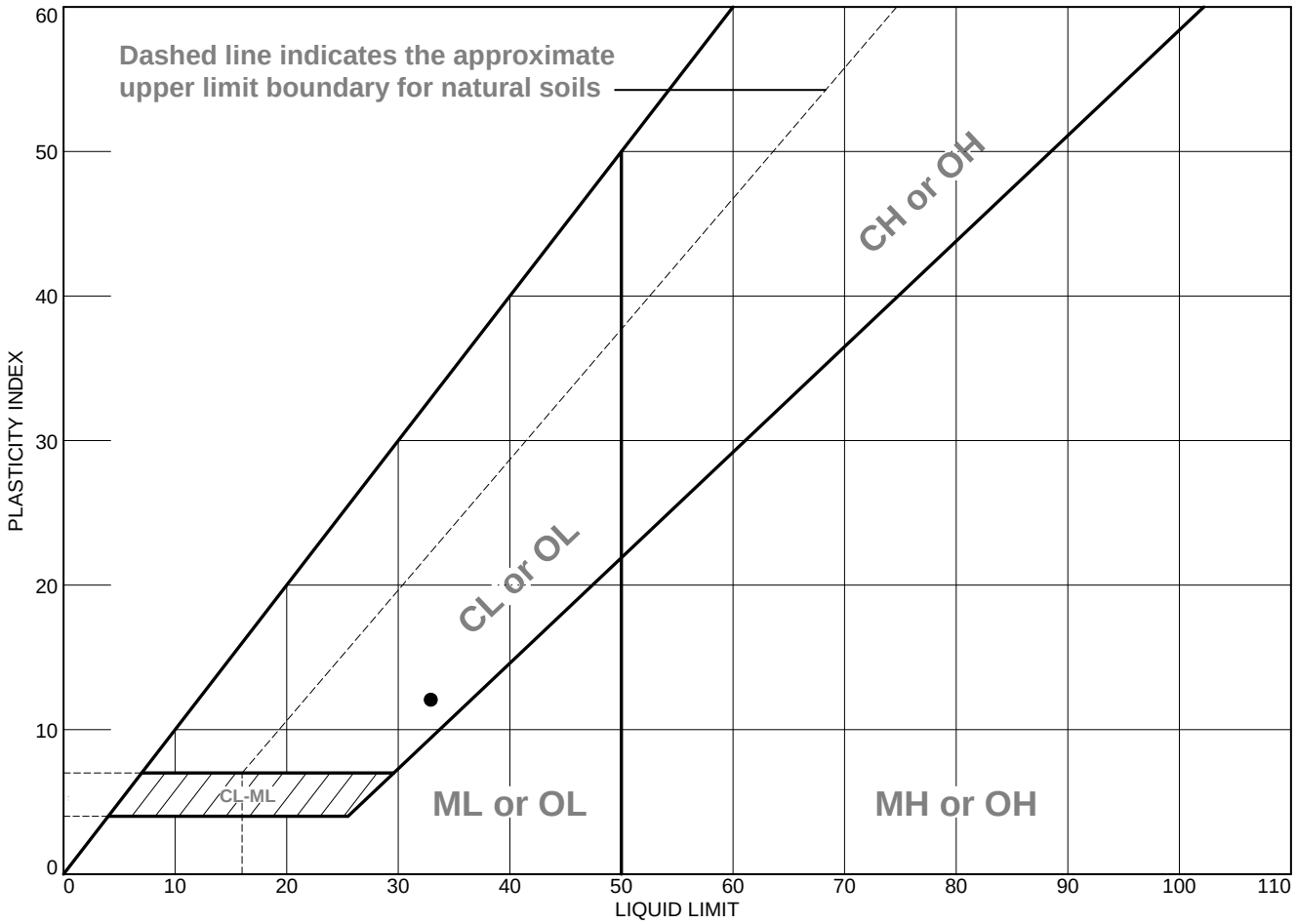
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SOFT TO STIFF, GRAYISH BROWN LEAN CLAY, DRY	33	21	12	96.8	94.0	CL

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

●**Source of Sample:** B1 **Depth:** 2 **Sample Number:** S2

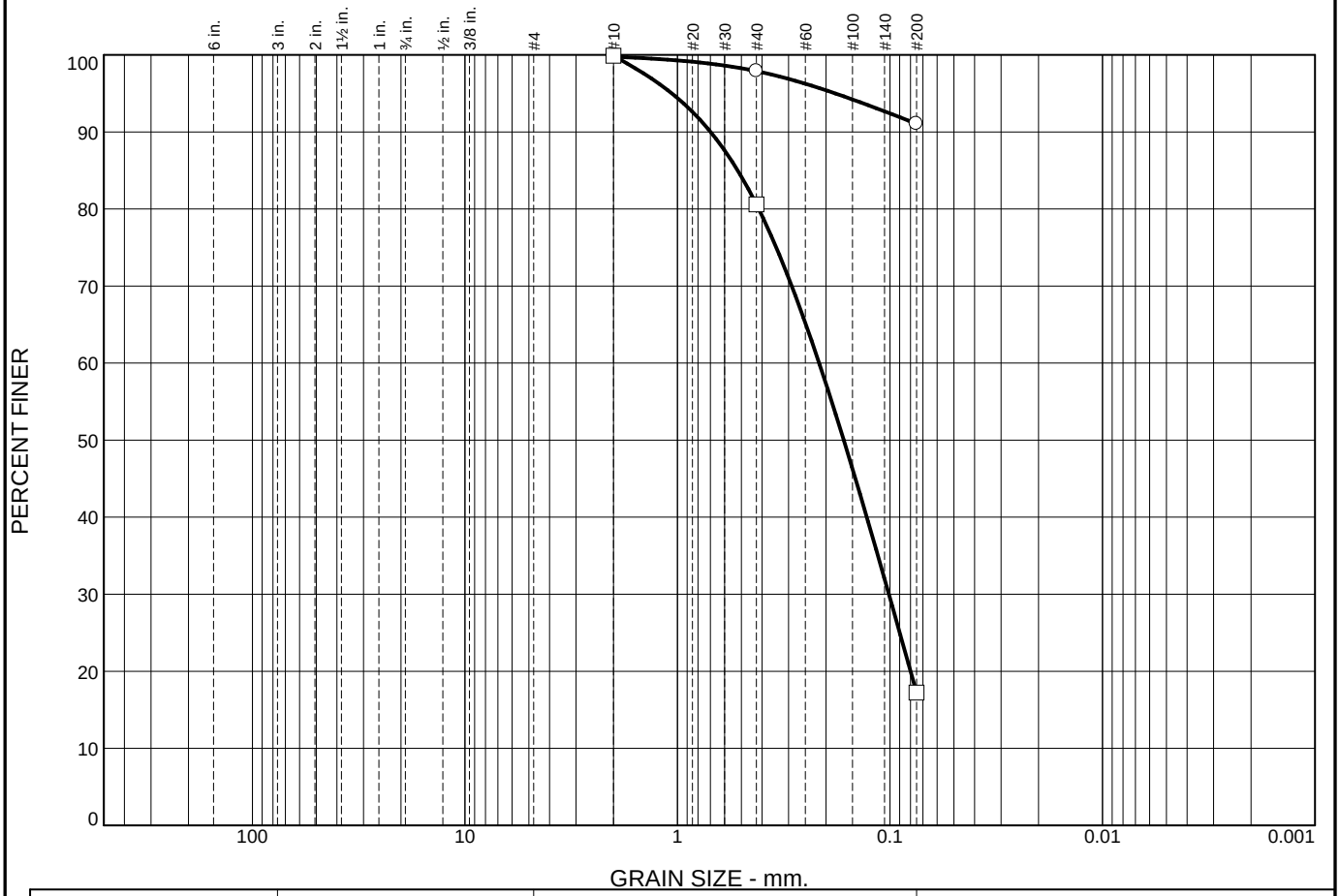
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○					1.9	6.8	91.1	
□					19.3	63.4	17.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	30	NP								
□	NV	NP	0.5207	0.2154	0.1650	0.1011				

	Material Description	USCS	AASHTO
○			A-4(1)
□	LOOSE, TAN SAND WITH SILT, MOIST	SM	A-2-4(0)

Project No. GEO25-217 **Client:**
Project: ASU CREST CENTER

○ **Source of Sample:** B3 **Depth:** 4 **Sample Number:** S3
□ **Source of Sample:** B3 **Depth:** 13.5 **Sample Number:** S6

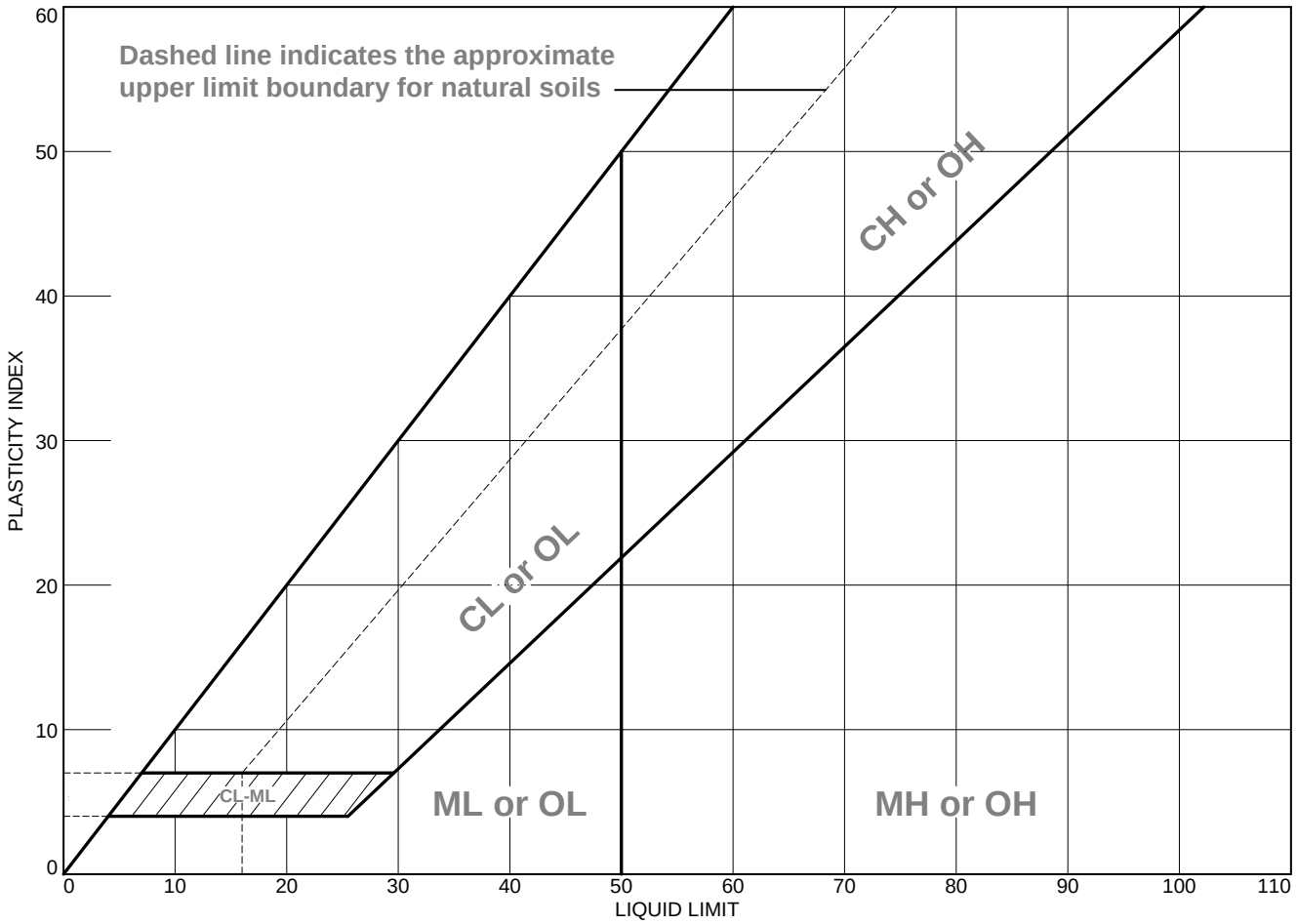
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		30	NP	NP	97.9	91.1	
■	LOOSE, TAN SAND WITH SILT, MOIST	NV	NP	NP	80.6	17.2	SM

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

●**Source of Sample:** B3 **Depth:** 4 **Sample Number:** S3

■**Source of Sample:** B3 **Depth:** 13.5 **Sample Number:** S6

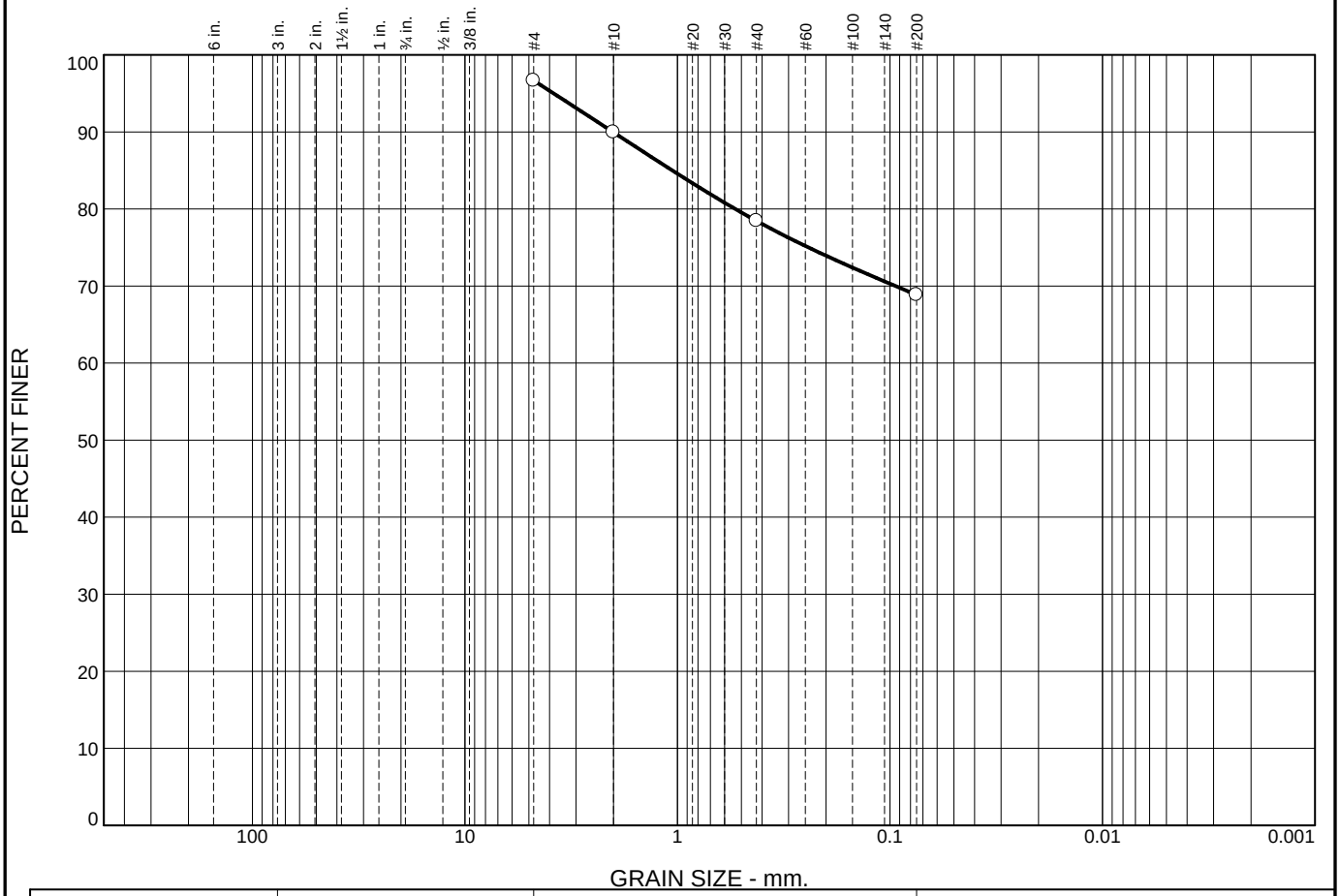
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				6.7	11.5	9.6	68.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	24	22	1.0570							

Material Description	USCS	AASHTO
○ WHITE/BROWN TO GRAYISH BROWN SILT WITH ORGANICS	ML	A-4(0)

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

○ **Source of Sample:** B4 **Depth:** 4 **Sample Number:** S3

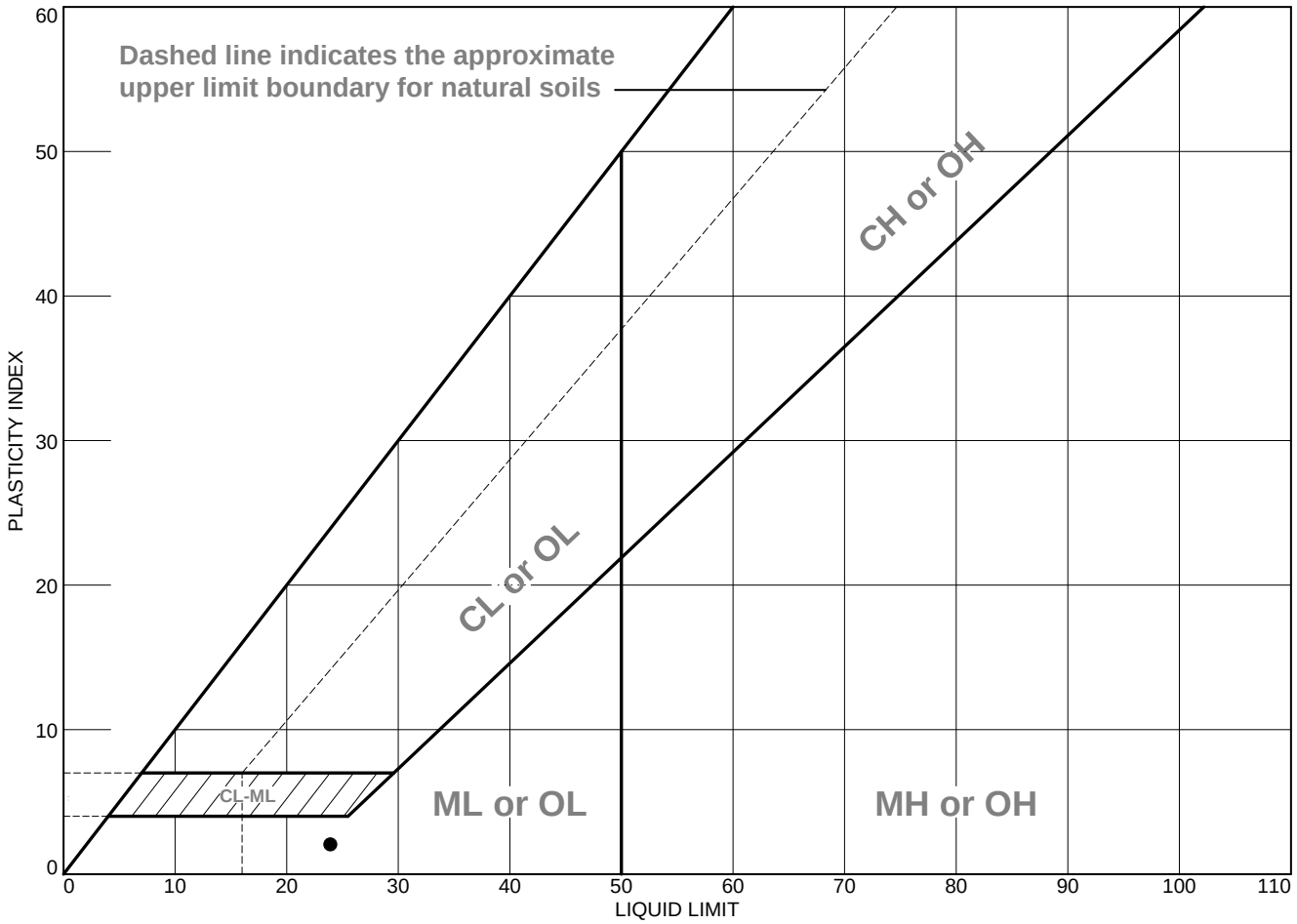
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	WHITE/BROWN TO GRAYISH BROWN SILT WITH ORGANICS	24	22	2	78.5	68.9	ML

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

●**Source of Sample:** B4 **Depth:** 4 **Sample Number:** S3

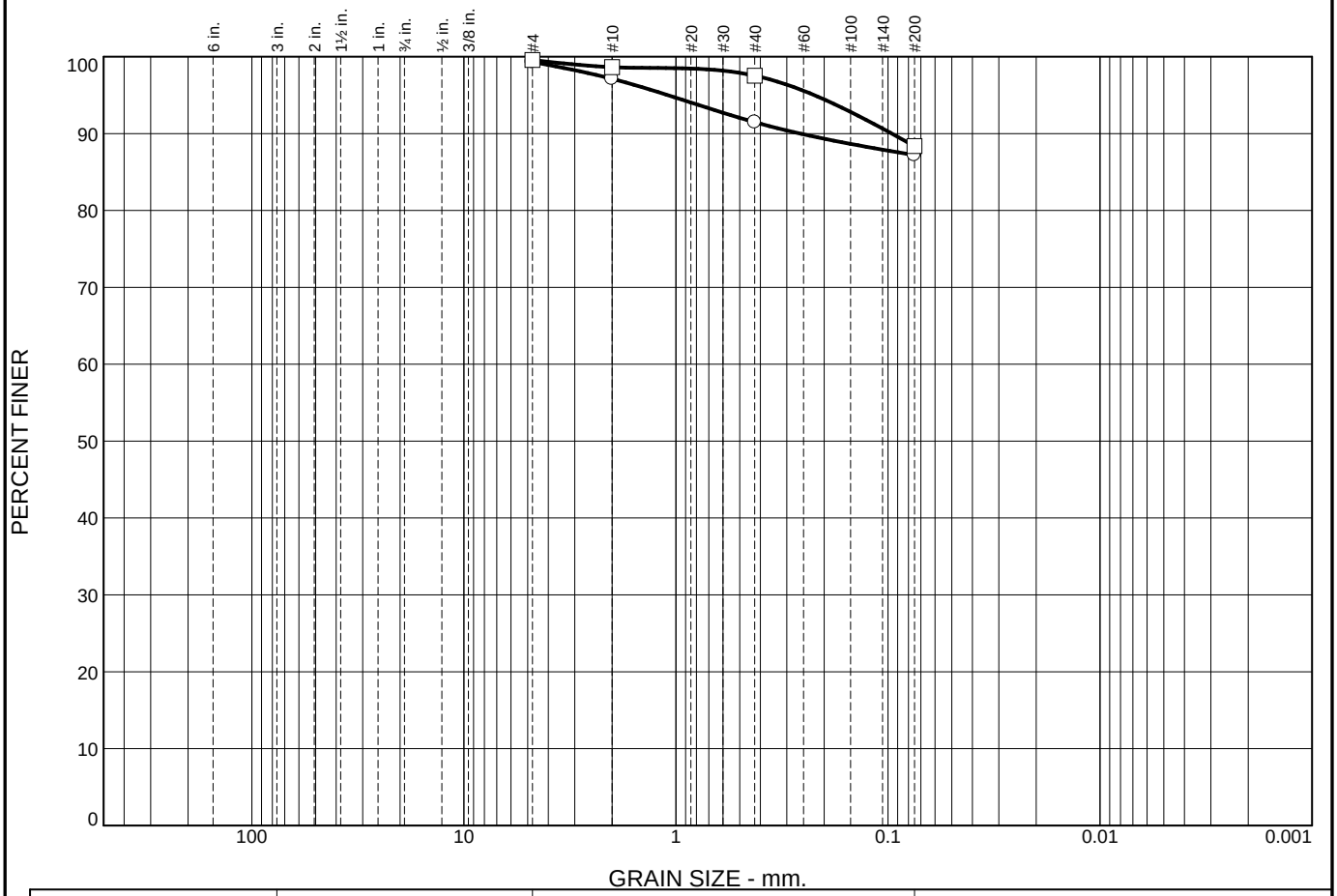
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				2.2	5.6	4.3	87.2	
□				1.0	1.1	9.1	88.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	26	NP								
□	35	26								

Material Description	USCS	AASHTO
○ VERY STIFF, GRAY SILT, DRY	ML	A-4(0)
□		A-4(9)

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

○ **Source of Sample:** B5 **Depth:** 2 **Sample Number:** S2

□ **Source of Sample:** B5 **Depth:** 8 **Sample Number:** S5

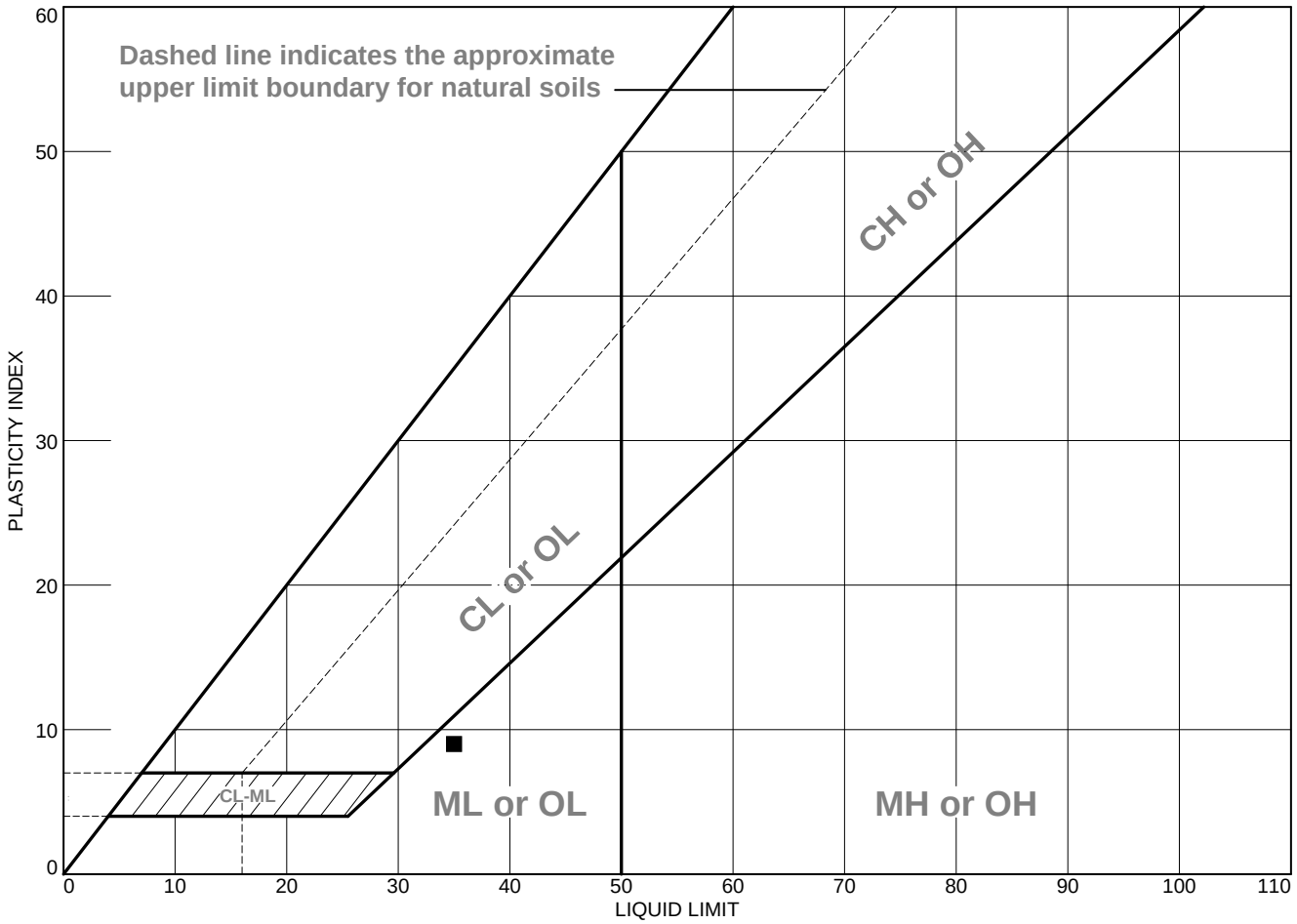
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	VERY STIFF, GRAY SILT, DRY	26	NP	NP	91.5	87.2	ML
■		35	26	9	97.5	88.4	

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

●**Source of Sample:** B5 **Depth:** 2 **Sample Number:** S2

■**Source of Sample:** B5 **Depth:** 8 **Sample Number:** S5

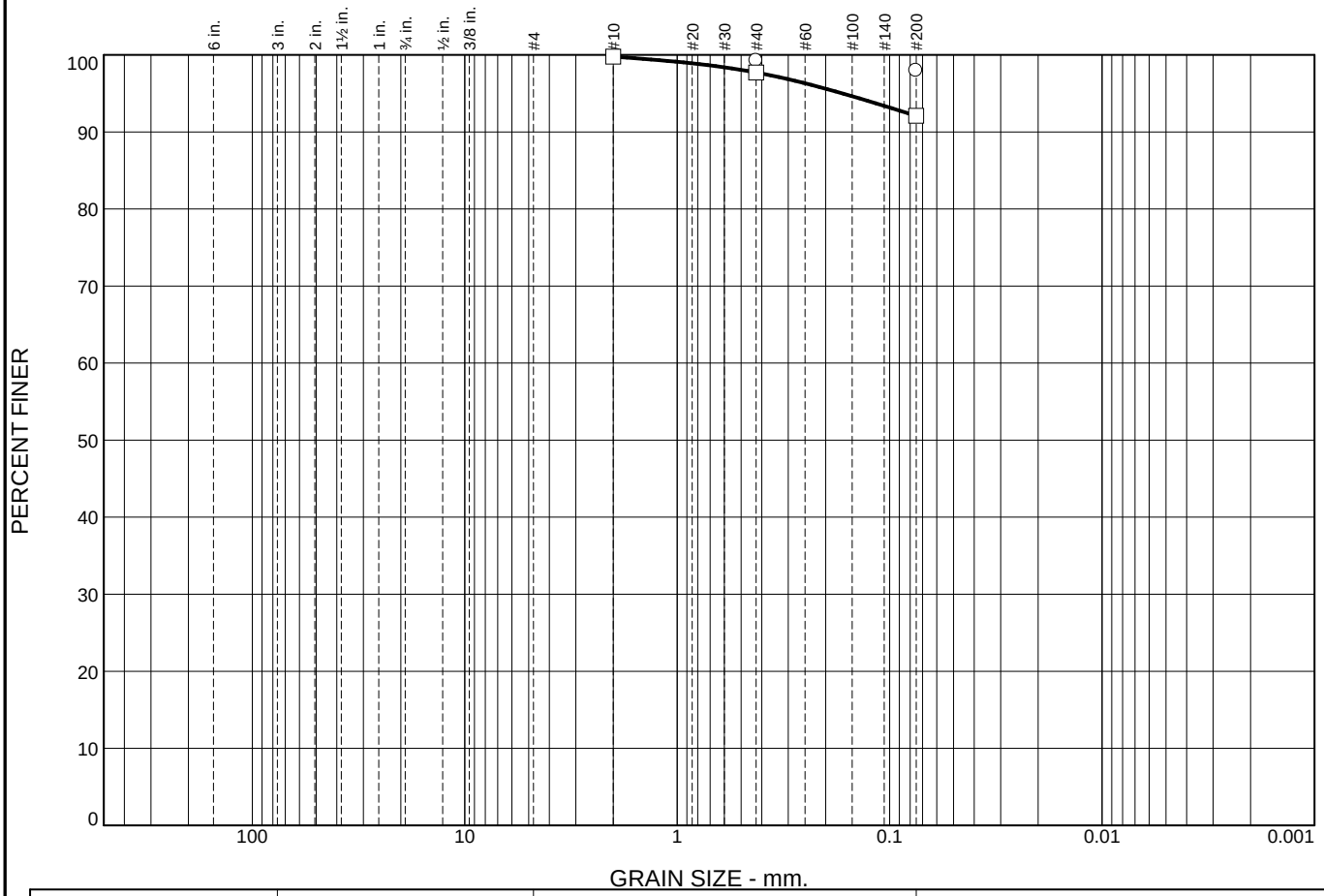
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○						1.2	98.0	
□					2.1	5.6	92.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	27	20								
□	26	19								

	Material Description	USCS	AASHTO
○			
□			A-4(5)

Project No. GEO25-217 **Client:**
Project: ASU CREST CENTER

○ **Source of Sample:** B6 **Depth:** 2 **Sample Number:** S2
□ **Source of Sample:** B6 **Depth:** 8 **Sample Number:** S5

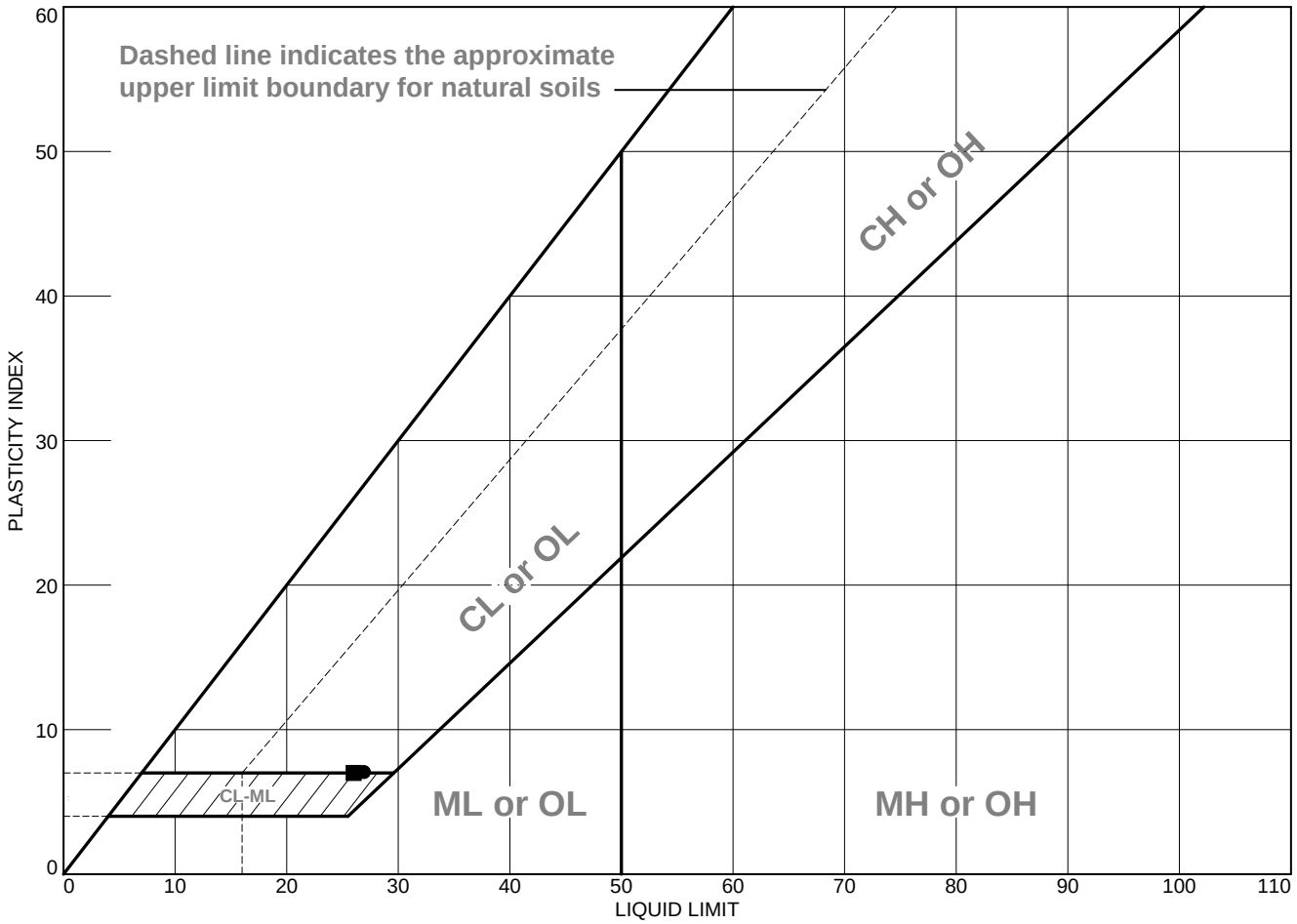
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		27	20	7	99.2	98.0	
■		26	19	7	97.7	92.1	

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

●**Source of Sample:** B6 **Depth:** 2 **Sample Number:** S2

■**Source of Sample:** B6 **Depth:** 8 **Sample Number:** S5

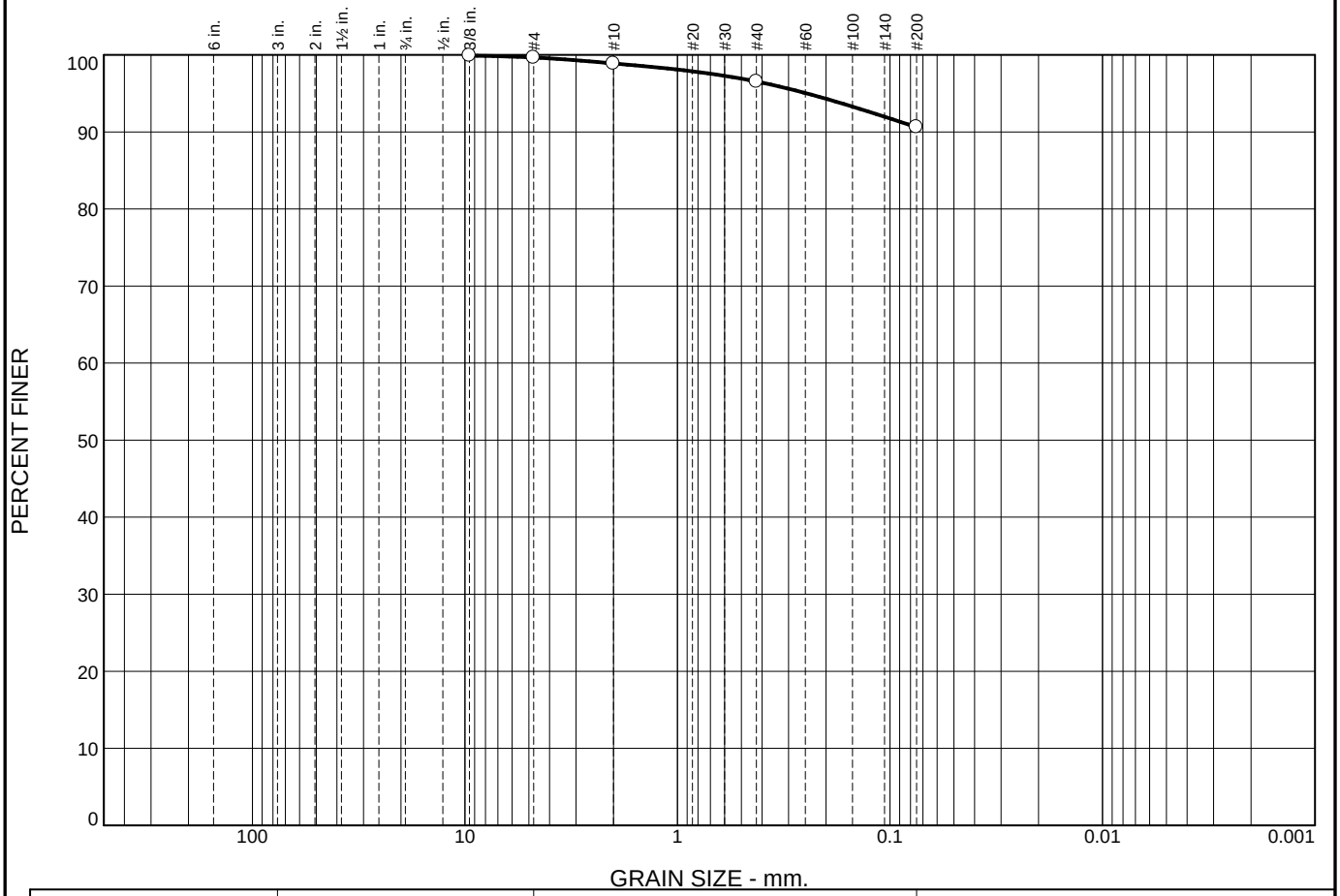
Remarks:

Materials Testing of Arkansas

Little Rock, AR

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.8	2.4	5.9	90.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

Material Description	USCS	AASHTO
○ STIFF TO FIRM, BROWNISH GRAY SILT, MOIST	ML	

Project No. GEO25-217 **Client:**

Project: ASU CREST CENTER

○ **Source of Sample:** B7 **Depth:** 4 **Sample Number:** S3

Remarks:

Materials Testing of Arkansas

Little Rock, AR

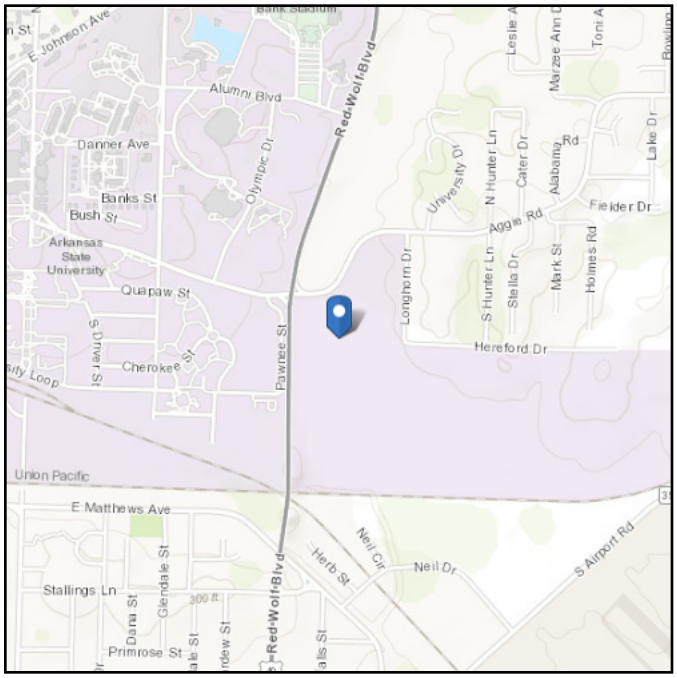
Figure

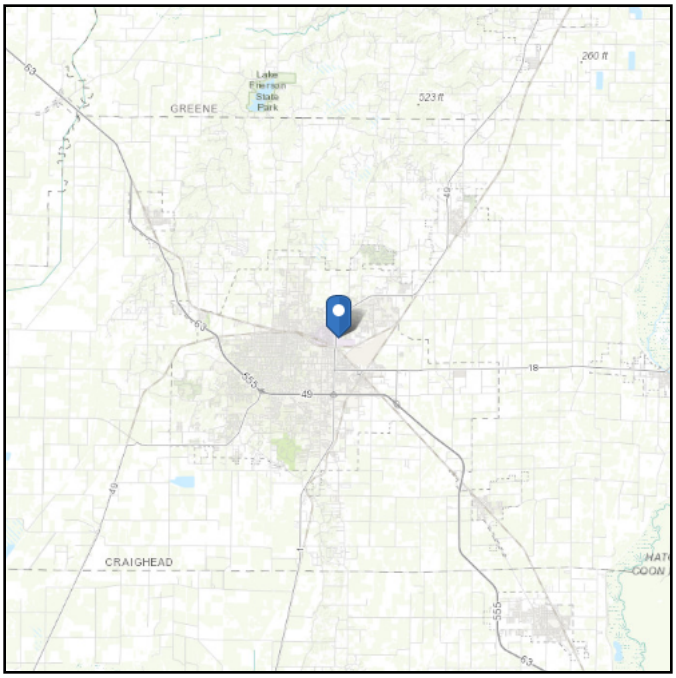
Appendix E:
Seismic Design Criteria

ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	35.839282
Risk Category:	II	**Longitude:**	-90.666197
Soil Class:	D - Stiff Soil	**Elevation:**	269.7131726334459 ft (NAVD 88)





Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.181	S_{D1} :	N/A
S_1 :	0.408	T_L :	12
F_a :	1.028	PGA :	0.712
F_v :	N/A	PGA_M :	0.784
S_{MS} :	1.214	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	0.809	C_v :	1.336

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Fri Nov 21 2025

Date Source: USGS Seismic Design Maps

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

A. Installation and removal of and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services and metering as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services and metering as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design", and, ICC A117.1.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Engineer, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk

height.

2.2 EQUIPMENT

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

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

G. Electric Power Service:

1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

a. Install electric power service underground unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary offsite parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

G. Waste Disposal Facilities:

1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
2. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control:

1. Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
2. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with erosion- and sedimentation-control Drawings,

requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection:

1. Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
2. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: Contractor shall submit a plan indicating the proposed location of site enclosure fence.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
2. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
3. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 311000 "Site Clearing" for limits on clearing; disposition of vegetative clearing debris.
2. Section 31 2000 "Earthwork" for temporary and permanent grade changes for erosion control.
3. Section 32 1123 "Aggregate Base Courses" for temporary and permanent roadways.

1.2 DEFINITIONS

A. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings, defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated, defined by a circle concentric with each tree with a radius 12 times the tree's caliper size and with a minimum radius of 96 inches unless otherwise indicated. Reference Demo and Tree Preservation Plan for tree protection fence locations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones.

C. Samples: For each type of the following:

1. Organic Mulch: 1-pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

D. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1.5 INFORMATIONAL SUBMITTALS

A. Certification: From ISA certified arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.

B. Maintenance Recommendations: From ISA certified arborist, for care and protection of trees affected by construction during and after completing the Work.

C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA,Licensed arborist in jurisdiction where Project is located, Current member of ASCA, Registered Consulting Arborist as designated by ASCA.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of 2 parts stockpiled soil to 1 part planting soil.
2. Planting Soil: Submit planting soil to Landscape Architect for approval.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch OD line posts, and 2-7/8-inch OD corner and pull posts; with 1-5/8-inch OD top rails, ; with 0.177-inch diameter top tension wire and 0.177-inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

a. Height: 48 inches.

2. Wood Protection-Zone Fencing: Constructed of two 2-by-4 inch horizontal rails, with 4-by-4-inch preservative-treated wood posts spaced not more than 96 inches apart, and lower rail set halfway between top rail and ground.

a. Height: 48 inches.

3. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi;secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.

a. Height: 48 inches.

4. Gates: Single- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width As indicated.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering, stating

"Notice: Tree Preservation Area DO NOT ENTER" or other verbiage as required by Urban Forester for the jurisdiction in which work will take place.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Tree-Protection Area: An Arborist shall examine all trees to remain and assess the health and maintenance needed for each individual tree. A report shall be generated from the Arborist and submitted to the Contractor, Owner and Landscape Architect.

3.2 PREPARATION

A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

B. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
3. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations

in a manner approved by Architect.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Landscape Architect and remove when construction operations are complete and equipment has been removed from the site.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Do not allow exposed roots to dry out before placing permanent backfill.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Temporarily support and protect roots from damage until they are permanently covered with soil.
3. Cover exposed roots with burlap and water regularly.
4. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots by hand or using an air spade of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune

branches as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1) and as indicated on Drawings.

B. Cut branches with sharp pruning instruments; do not break or chop.

C. Chip removed branches and spread over areas identified by Architect.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

C. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

B. Reports: All trees disturbed or damaged within a tree protection area or easement are to be assessed and a report produced by an arborist. All trees to remain are to be evaluated individually in a report by an arborist. Report is to be reviewed and approved by the Landscape Architect. All associated cost of arborist and associated work recommended in reports are to be at the contractor’s expense. Including but not limited to pruning, dead wooding, tree removal and legal disposal of material offsite.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
2. Replace trees and other plants that cannot be repaired and restored to full-growth

status, as determined by Architect.

B. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 4-inch uniform thickness to remain.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 015713 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.2 RELATED REQUIREMENTS

A. Section 31 1000 "Site Clearing" for limits on clearing, disposition of vegetative clearing debris.

B. Section 31 2000 "Earth Moving" for temporary and permanent grade changes for erosion control.

C. Section 32 1123 "Aggregate Base Courses" for temporary and permanent roadways.

1.3 PERFORMANCE REQUIRMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency (EPA)and Arkansas Department of Environmental Quality (ADEQ) for erosion and sedimentation control.

1. Comply with requirements and recommendations of the EPA National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP)
2. Comply with requirements and recommendations of the ADEQ Construction Stormwater Discharge Permit ARR150000.
3. Comply with requirements and recommendation of the ADEQ Short Term Activity Authorization Permit, Specification Section 001001.

B. Comply with requirements of State of Arkansas, Erosion and Sedimentation Control Manual.

C. Comply with requirements of the City of Jonesboro.

D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit weekly

inspection reports.

E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

1. Obtain and pay for permits and provide security required by authority having jurisdiction.

F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

G. Timing: Put preventive measures in place prior to disturbance of surface cover and before precipitation occurs.

H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.

1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.

1. Control movement of sediment and soil from temporary stockpiles of soil.
2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.

1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.
3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventative measures until permanent measures have been established.

O. All area left disturbed longer than 14 days shall be vegetated and/or stabilized.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Erosion and Sedimentation Control Plan:

1. Submit within 2 weeks after Notice to Proceed.
2. Include:

a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
e. Other information required by law.
f. Format required by law is acceptable, provided any additional information specified is also included.

3. Obtain the approval of the Plan by authorities having jurisdiction.
4. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

E. Maintenance Instructions: Provide instructions covering inspection and maintenance for

temporary measures that must remain after Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mulch: Use one of the following:

1. Straw or hay, certified weed seed free ‘clean’.
2. Erosion control matting or netting, bio- or photo-degradable straw, coconut, coir or jute.
3. 100% Wood Fiber Hydroseeding Mulch

B. Grass Seed for Temporary Cover: If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

1. Summer Temporary Cover: May -September shall be Browntop Millet seeded at 100 lbs per acre and Plains Coreopsis seeded at 2 lbs per acre.
2. Winter Temporary Cover: September-May – shall be Cereal Rye -Secale cereale grain – 200 lbs/acre.

C. Stakes: One of the following, minimum 3 feet long:

1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
2. Wood, 2 by 2 inches in cross section.

D. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:

1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D 4751.
2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D 4491.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D 4632.
5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D 4632.
6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D 4533.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

E. Silt Fence Posts: One of the following, minimum 5 feet long:

1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.

F. Gravel: See Section 32 1123 for aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.

1. Width: As required; 20 feet, minimum.
2. Length: 50 feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.

1. Provide linear sediment barriers:

a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
b. Along the toe of cut slopes and fill slopes.
c. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
d. Across the entrances to culverts that receive runoff from disturbed areas.

2. Space sediment barriers with the following maximum slope length upslope from barrier:

a. Slope of Less Than 2 Percent: 100 feet..
b. Slope Between 2 and 5 Percent: 75 feet
c. Slope Between 5 and 10 Percent: 50 feet.
d. Slope Between 10 and 20 Percent: 25 feet.
e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:

1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use on piece of fabric wrapped at least 1-1/2 times around concrete blocks

and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
2. Straw bale row blocking entire inlet face area; anchor into pavement.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Soil Stockpiles: Protect using one of the following measures:

1. Cover with polyethylene film, secured by placing soil on outer edges.
2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

I. Temporary Seeding: Use where temporary vegetated cover is required.

3.4 INSTALLATION

A. Traffic-Bearing Aggregate Surface:

1. Excavate minimum of 6 inches.
2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:

1. Store and handle fabric in accordance with ASTM D 4873.
2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
5. Install with top of fabric at nominal height and embedment as specified.

3.5 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by the Engineer of Record.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

3.6 MAINTENANCE

A. Contractor shall maintain, repair, replace or add best management practices and structural erosion and sediment controls as necessary or required to maintain project compliance with all applicable local, state and federal requirements, including Project specific Permits.

3.7 WARRANTY

A. Contractor shall warrant the project for Permit compliance for the duration of all project work or project area surface disturbance and for one year after project completion, whichever is longer.

B. Contractor shall pay for any and all fines, fees or costs incurred by the Project or Owner for non-compliance with Permit requirements.

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

    a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Installation.
2. Cutting and patching.
3. Coordination of Owner's portion of the Work.
4. Protection of installed construction.
5. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products and limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect in writing.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.4 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
3. Mechanical and Electrical Services: Cut off pipe or conduit to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
4. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.6 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Submittal of Project warranties.
4. Final cleaning.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Complete final cleaning requirements.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.5 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Owner.

D. Warranties in Paper Form:

1. Submit hardcopies per Owner’s instructions.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

B. Construction Waste Disposal: Comply with waste-disposal requirements established by federal, state, and local laws.

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

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

C. Section 017700 - Execution Requirements: Contract closeout procedures.

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

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

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Fennell Purifoy Architects with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Fennell Purifoy Architects will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by the owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Fennell Purifoy Architects comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in electronic format in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with the 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; 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.
   7. The above set is for project coordination only.

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

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish main 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.

F. Submit one link for download containing closeout documents, owner & maintenance manuals, copies of all approved submittals and as-built drawings to architect. Provide hardcopy as requested by owner.

3.02 OPERATION AND MAINTENANCE DATA

A. For Each Product or System: List names, addresses and telephone numbers 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.

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.

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. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

C. Include color coded wiring diagrams as installed.

D. 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.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

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

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

H. Include sequence of operation by controls manufacturer.

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

J. Provide control diagrams by controls manufacturer as installed.

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

3.05 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 the owner’s permission, leave date of beginning of time of warranty until the 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. Manual: Prepare data in the form of the warranties and bonds electronically.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.

B. This Section includes the Commissioning (Cx) requirements for the Plumbing, HVAC, and Electrical systems.

C. The Building Systems Commissioning requirements given in this section are separate from and in addition to any other Equipment/Systems Testing, Demonstration or Commissioning requirements specified in other specification sections of the Project Manual.

1.02 DESCRIPTION

A. Commissioning is a systematic process of ensuring all building systems perform interactively according to design intent and Owner's operational needs. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, equipment Start-Up, control system calibration and point-to-point checkout, testing and balancing, and Functional Performance Testing. Commissioning is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify and document proper installation and performance of equipment and systems.

2. Provide Owner with functional buildings and/or systems with minimal operational problems at time of move-in.

B. Commissioning does not take away from or reduce responsibility of system designers or installing contractors to provide a finished and fully functioning product.

C. This Section shall in no way diminish the responsibility of the Division 22, 23, and 26 Contractors, Subcontractors and Suppliers in performing all aspects of work and testing as outlined in the contract documents. The Building Systems Commissioning requirements outlined in this specification are separate from and in addition to any other testing, demonstration, or commissioning requirements in other Division specifications.

1.03 ABBREVIATIONS

A. The following are common abbreviations used in the Specifications (definitions are found further in this Section):

1. A/E - Architect and Design Engineers
2. BAS - Building Automation System
3. CC - Controls Contractor
4. CM - Construction Manager
5. CT - Commissioning Team
6. Cx – Commissioning
7. CxA - Commissioning Agent
8. Cx Plan - Commissioning Plan
9. EC - Electrical Contractor
10. FPT - Functional Performance Test
11. MC - Mechanical Contractor
12. O&M - Operations & Maintenance
13. OR - Owner's Representative
14. PC – Plumbing Contractor
15. PFC - Pre-Functional Checklist
16. TAB - Test, Adjust and Balance
17. RFI - Request for Information

1.04 DEFINITIONS

A. Acceptance Phase: Phase of construction after Start-Up and initial checkout when Functional Performance Tests occur.

B. Approval: Acceptance that a piece of equipment or system has been properly installed and functioning in tested modes according to the Contract Documents.

C. Architect/Engineer (A/E): Prime consultant (architect) and sub-consultants who comprise the design team, generally HVAC Mechanical Designer/Engineer and Electrical Designer/Engineer.

D. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions and methods chosen to meet intent.

E. Commissioning Agent (CxA): Contracted to Owner. CxA directs and coordinates day to-day Building Systems Commissioning activities. CxA reports directly to Owner.

F. Commissioning (Cx) Database - A "cloud-based" process management platform provided by the CxA utilized to execute the Commissioning process.

G. Commissioning Plan: Overall plan developed after bidding that provides structure, schedule and coordination planning for Commissioning process.

H. Contract Documents: Documents binding on parties involved in construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).

I. Contractor: Contracted directly to Owner.

J. Control System: System and components associated with building automation system.

K. Deferred Functional Tests: Functional tests performed after Substantial Completion due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow test from being performed.

L. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents (that is, does not perform properly or is not complying with design intent).

M. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with contract documents. Functional Performance Tests are executed after Pre-Functional Checklists and Start-Ups are complete.

N. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions that fully describe system configuration and steps required to determine if the system is performing and functioning properly. These procedures shall be used to document Functional Performance Tests.

O. Monitoring: Recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or trending capabilities of control systems.

P. Overridden Value: Writing over a sensor value in control system to see response of a system (e.g., changing outside air temperature value from 52oF to 72oF to verify economizer operation). See also "Simulated Signal".

Q. Pre-Functional Checklist (PFC): A list of static inspections and elementary component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.).

R. Seasonal Performance Tests: Functional Performance Tests deferred until system(s) ambient conditions are closer to design conditions.

S. Simulated Condition: Condition created for testing component or system (e.g., applying heat to space temperature sensor to monitor response of VAV box).

T. Simulated Signal: Disconnecting sensor and using signal generator to send amperage, resistance or pressure to transducer and/or DDC system to simulate value to BAS.

U. Specifications: Construction specifications of Contract Documents.

V. Start-up: The activities where systems or equipment are initially tested and operated. Start-up is completed prior to Functional Performance Testing.

W. Subcontractor: Contractors of CM, and their Subcontractors, who provide and install building components and systems.

X. Test Procedures: Step-by-step process, which must be executed to fulfill test requirements.

Y. Test Requirements: Requirements specifying what modes and functions, etc. will be tested. Test requirements are not detailed test procedures. Test requirements are specified in the Cx Plan.

Z. Trending: Monitoring using building control system.

AA. Vendor: Supplier of equipment.

BB. Warranty Period: Warranty period for entire project, including equipment components.

1.05 RELATED WORK

A. Specific Building Systems Commissioning requirements are given in this specification. The following specifications are related to Work specified in this Section:

1. Basic Plumbing System Requirements: Refer to Division 22.
2. Basic HVAC System Requirements: Refer to Division 23
3. Basic Electrical System Requirements: Refer to Division 26.

1.06 COORDINATION

A. Commissioning Team: Members of the Commissioning Team (CT) will consist of:

1. Commissioning Agent (CxA).
2. Owner's Representative(s) (OR).
3. Representatives of the Facility User and Operation and Maintenance Personnel.
4. Architect and Design Engineers (A/E).
5. Construction Manager (CM)
6. Mechanical Contractor (MC).
7. Plumbing Contractor (PC).
8. Electrical Contractor (EC).
9. Test and Balance Contractor (TAB Contractor).
10. Controls Contractor (CC).
11. Any other Division 22, 23, or 26 Contractors or Subcontractors who provide and install the equipment to be commissioned.
12. Equipment Suppliers and Vendors.

B. Management: Owner will contract services of the CxA. The CxA directs and coordinates Commissioning activities and reports to OR. All members of the Commissioning Team shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.

C. Kick-Off Meeting: CxA will plan, schedule and conduct a Commissioning Kick-Off Meeting. Membership and responsibilities of the Commissioning team will be clarified at this meeting. Cx Kick-Off Meeting shall be conducted no later than 30 days prior to initial installation of any

commissioned equipment on-site (i.e. equipment set on site). CxA will distribute meeting minutes to all parties.

D. Scheduling:

1. CxA will work with Commissioning team to establish required Commissioning activities to incorporate in preliminary Commissioning schedule. The CM will integrate Commissioning activities into master construction schedule. Representatives of the Commissioning team will address scheduling problems. Necessary notifications are to be made in a timely manner to expedite Commissioning.

2. The CxA will provide initial schedule of primary Commissioning events at Commissioning Kick-Off Meeting. As construction progresses, more detailed schedules are developed by the Commissioning team.

E. Project Phasing:

1. Phased completion of project construction is not anticipated (i.e. single move-in and occupancy period). All CxA work except the following must be completed prior to Owner move-in/occupancy: a. Compilation and delivery of Final Commissioning Report.

PART 2 - PRODUCTS / COMMISSIONING DOCUMENTATION

2.01 COMMISSIONING (CX) DATABASE

A. The Commissioning process will be executed utilizing a “cloud-based” process management Database provided by the CxA. Cx Database is accessed by authorized users using any device running an HTML-5 internet browser (e.g. PC, laptop, tablet, phone) or by an operating system specific (e.g. iOS) application downloaded from corresponding app store.

B. CxA will provide the CM/Subcontractors with web access to the Cx Database during the Commissioning process to allow the CM/Subcontractors to complete the scoped Commissioning tasks indicated in other Sections of this specification (e.g. completion of Commissioning activities such as notification of deficiency item corrections, readiness for Functional Performance Testing, etc.).

2.02 COMMISSIONING PLAN

A. CxA will develop overall plan for execution of the Commissioning Process. CxA will provide a single overall Commissioning Plan for all phases of work.

B. The Cx Plan will contain:

1. Executive Summary of overall commissioning process.

2. List of CT members and roles and responsibilities.

3. Master Equipment List (list of commissioned equipment and systems).

4. Pre-Functional Checklists (PFCs) for commissioned equipment. The PFCs will be developed in the Cx Database.

5. Functional Performance Test Procedures for each commissioned equipment/system. The FPTs will be developed in the Cx Database. The initial Cx Plan will not include the FPTs; these will be developed once the Control Submittal is approved by the A/E.

6. Sample Master Issues Log (used to track issues/deficiencies throughout the commissioning process). The MIL will be developed in the Cx Database.

C. The Cx Plan will be delivered to the CT in electronic format (Adobe PDF file searchable from the Table of Contents). Updates to the Cx Plan PFC and FPT documentation will be made available to the CT via the Cx Database.

2.03 COMMISSIONED EQUIPMENT SUBMITTAL AND O&M DATA

A. Contractor shall provide CxA with documentation required for Commissioning work. At minimum, documentation shall include: Requirements as described in Section 013300, detailed Start-Up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, duct pressure testing procedures and results, piping pressure testing and flushing procedures and results, control drawings and details of Owner contracted tests. In addition, installation and checkout materials shipped inside equipment and actual field checkout sheet forms used by factory or field technicians shall be submitted to CxA.

B. CM shall submit one copy of the final A/E approved submittal data to the CxA for commissioning purposes.

2.04 EQUIPMENT NAMEPLATE DOCUMENTATION

A. CM/Subcontractors shall submit the following information to the CxA for each item of commissioned equipment. The information will be input by CM/Subcontractors into the Cx Master Equipment List spreadsheet (Microsoft Excel - .xls format) provided by the CxA. The information shall be provided to the CxA prior to equipment installation:

1. Equipment Manufacturer.

2. Equipment Model Number.

3. Equipment Serial Number.

2.05 SITE VISIT REPORTS

A. CxA will make periodic site visits to complete scoped commissioning work. CxA will provide a report for each site visit to members of the CT.

B. CxA Site Visit Report will include the following:

1. Attendees and purpose of site visit.

2. Observations regarding commissioned systems and results of completed commissioning work.

3. “Next Steps” section documenting Cx process status and upcoming Cx work / site visits.

4. Current Master Issues Log (MIL).

5. Status Report of CM/Subcontractor PFC completion.

6. Picture Report (where applicable).

2.06 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. The objective of the Pre-Functional Checklist is to verify and document that the equipment/systems are provided and installed according to documented design intent and Contract Documents.

B. CxA will develop the Pre-Functional Checklists from the Contract Documents and A/E approved Equipment Submittals. The Pre-Functional Checklists will be developed in the Cx Database. The Pre-Functional Checklists will be completed during construction in the Cx Database by the CM and installing Subcontractors:

C. Sample Pre-Functional Checklists are included at the end of this specification. The sample Pre-Functional Checklists are provided to give the Subcontractors a general idea of the work required to complete the Pre-Functional Checklists. The sample Pre-Functional Checklists are prototypical, and do not reflect specific requirements of this project’s plans or specification. Specific Pre-Functional Checklist items may be added, modified or deleted in the Construction Phase Cx Plan delivered to the Subcontractor to reflect the final construction document requirements. CM and Subcontractors shall review final construction documentation for applicable details and specifications related to equipment to be commissioned to fully ascertain all the Pre-Functional Checklist requirements.

2.07 CM / SUBCONTRACTOR START-UP PLAN

A. CM/Subcontractors responsible for purchase, installation and Start-Up of commissioned equipment shall compile all testing and equipment Start-Up documentation into an overall Start-Up Plan document.

B. Start-Up Plan shall include the following documentation:

1. Testing Documentation:

a. CM/Subcontractor shall compile documentation and recording forms for all testing required by Division 22, 23, and 26 specifications (e.g. duct pressure testing, duct cleaning, pipe pressure testing, piping flushing and cleaning plans, electrical testing, communications cabling testing, fire alarm component testing, security systems testing, etc.). Testing documentation shall include:

1) A written description of the required testing and the procedures required to complete the testing.

2) All instrumentation utilized for the testing.

3) Checklist with boxes or lines for recording and documenting the completion of the testing activity and results.

2. Equipment Start-Up Documentation:

a. CM/Subcontractor shall compile detailed Start-Up procedures from equipment manufacturer and checkout procedures with normally used field checkout sheets. Start-up documentation shall include checklists and procedures with specific boxes or lines for recording and documenting inspections of each piece of equipment.

3. Control System Start-Up Documentation:

a. CM/Controls Contractor shall compile all control systems Start-Up and initial check-out documentation and recording forms including but not limited to point-to-point verifications, control sensor calibrations, and control valve/damper actuator calibrations for inclusion in the Start-Up Plan. Control System Start-up documentation shall include checklists and procedures with specific boxes or lines for recording and documenting inspections of each control system point, sensor or device.

4. Test and Balance Documentation:

a. Start-Up Plan documentation shall include the TAB Execution Plan outlining the TAB procedures and proposed sequencing and scheduling of required TAB work.

5. Equipment Maintenance Log:

a. Start-Up Plan documentation shall include a list of all maintenance tasks (including frequency of execution) required to be performed on equipment started to ensure equipment warranties are not voided. Start-Up Plan documentation shall include a log for each required maintenance task for Subcontractor/Vendor to document execution of the required maintenance tasks from Start-Up through Final Application for Payment.

C. Start-Up Plan documentation shall be provided in “searchable” electronic PDF format as follows:

1. Provide a separate Start-Up Plan PDF file for each Division of work (e.g. Division 22 Start-Up Plan, Division 23 Start-Up Plan, Division 26 Start-Up Plan, etc.)

2. Each Start-Up Plan PDF file will have a Cover Sheet with Project Information and Document Title.

3. Each Start-Up Plan PDF file will have a Table of Contents. The Table of Contents shall be "bookmarked" for hyperlink navigation directly to each Section and item/document noted below.

   a. Proposed Schedule/Sequencing Plan of Testing and Start-Up activities.

   b. Testing documentation (e.g. duct pressure testing, duct cleaning, piping pressure testing, piping flushing and cleaning, electrical testing, etc.) organized by specification Section.

   c. Start-Up Checklists for each item of equipment organized by specification Section.

   d. Control System Start-Up activities completed by the Controls Contractor including but not limited to all point-to-point verifications, control sensor calibrations and control actuator calibrations.

   e. Warranty Maintenance Log for each item of equipment organized by specification Section.

   f. TAB Execution Plan.

2.08 BUILDING AUTOMATION SYSTEM (BAS) TREND DATA

A. Mechanical, Plumbing, Medical Gas and Electrical Systems operation will be monitored and analyzed by the CxA utilizing trend data provided from the Building Automation System.

B. The Controls Contractor for this project shall provide trend data for all commissioned equipment/systems monitored or controlled by the Building Automation System. The complete cost for the Controls Contractor to set up ALL required trending and reporting shall be included in the project contract cost.

2.09 FUNCTIONAL PERFORMANCE TESTS (FPT)

A. CxA will develop the Functional Performance Testing procedures from the Contract Documents and A/E approved BAS Control Submittal. The Functional Performance Test Procedures will be developed in the Cx Database. The Functional Performance Tests will be executed by the CM/Subcontractors. The CxA will witness the Functional Performance Testing and document the results in the Cx Database.

B. Development of Test Procedures:

1. The purpose of any given specific test is to verify and document compliance with stated criteria of acceptance given on test form. CxA shall develop specific test procedures and forms to verify

and document proper operation of each piece of equipment and system. Subcontractor responsible to execute test will provide limited assistance to CxA in developing procedure (i.e. answering questions about equipment, operation, sequences, etc.). Prior to execution, CxA shall provide a copy of test procedures to Subcontractor. Subcontractor will review tests for feasibility, safety and equipment warranty protection. CxA shall submit tests to Owner, CM and A/E and other Commissioning team members for review.

2. Test procedure forms developed by the CxA will include (but not be limited to) the following information:

   a. System and equipment or component name(s)

   b. Equipment location and ID number

   c. Date

   d. Project name

   e. Participating parties

   f. Specific sequence of operation or other specified parameters being verified

   g. Instructions for setting up test

   h. Specific step-by-step procedures to execute test, in a clear, sequential and repeatable format

   i. A Yes/No checkbox to allow for clearly marking whether proper performance of each part of test was achieved

   j. Section for comments

3. Sample Functional Performance Test (FPT) forms are included at the end of this specification. The sample Functional Performance Tests are provided to give the Subcontractors a general idea of the work required to complete the FPT. The sample FPT forms included are prototypical, and do not reflect specific requirements of this project's plans or specification. Specific FPT items may be added, modified or deleted in the Cx plan delivered to the Subcontractor to reflect the final construction document requirements. CM and Subcontractors shall review final construction documentation for applicable details and specifications related to equipment to be commissioned to fully ascertain all the FPT requirements.

2.10 MASTER ISSUES LOG (MIL)

A. Any issues noted by CxA are tracked in a Master Issues Log (MIL). The MIL will be developed in and accessed/tracked through the Cx Database.

2.11 TEST EQUIPMENT

A. Division contractors shall provide all specialized tools, test equipment and instruments required to execute Start-Up, checkout and Functional Performance Testing of equipment under their contract.

B. Test equipment shall be of sufficient quality and accuracy to test and/or measure system performance with tolerances specified. A testing laboratory shall have calibrated test equipment within the previous 12 months. Calibration shall be NIST traceable. Equipment shall be calibrated according to manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

2.12 FINAL COMMISSIONING REPORT

A. The CxA Final Commissioning Report will include:

1. Executive Summary including:

a. List of Commissioned Equipment/Systems.

b. List of participants and roles.

c. Overview of Commissioning and testing scope and general description of testing and verification methods.

d. Evaluation regarding disposition of equipment, systems and documentation in the following areas:

1) Conformance to specifications and design intent.

2) Equipment installation.

3) Functional performance.

4) Recommendations for improvement to equipment or operations, future actions, etc. will also be listed

2. Master Issues Log.

3. Executed Pre-Functional Checklists.

4. Executed Functional Performance Tests.

5. Site Visit Reports.

6. Design Phase Cx Documentation.

PART 3 – EXECUTION

3.01 COMMISSIONING OVERVIEW

A. The following provides a brief overview of typical Commissioning tasks during construction and general order in which they occur:

1. CxA develops project specific Commissioning Plan in the Cx Database including specific Pre-Functional Checklists and equipment and system Functional Performance Test procedures. Commissioning team members are provided web access to the Cx Database for review of the Cx Plan prior to Cx Kick-Off meeting.

2. Commissioning during construction begins with a Kick-Off Meeting conducted by CxA where membership of Commissioning team is established, and responsibilities reviewed. The Commissioning Plan is reviewed during this meeting.

3. CxA schedules subsequent meetings as necessary to plan, coordinate and schedule Commissioning activities. Deficiencies and problem resolution will also be discussed at these meetings. CxA will participate in a total of six (6) meetings by teleconference/web-conference.

4. CM submits copies of final A/E approved submittals for all equipment to be commissioned to CxA for review. CxA revises Cx Plan if required.

5. Subcontractors install commissioned equipment/systems and execute Pre-Functional Checklists in Cx Database in phases as the work is completed.

6. CxA will conduct one (1) site visit prior to Functional Performance Testing to review commissioned equipment installations and sample verify Pre-Functional Checklists completed by Subcontractors. Subcontractors provide the necessary personnel to assist CxA (e.g. remove A/C unit covers, open electrical panel covers, etc.) with sample PFC verifications.

7. Any issues noted by CxA are tracked in a Master Issues Log (MIL) on the Cx Database platform. CM/Subcontractors correct issues noted by CxA and update MIL in Cx Database for CxA verification of issue corrections.

8. CM/Subcontractors develop Start-Up Plans. CM and Subcontractors coordinate overall schedule of equipment/systems Testing and Start-Up and submit schedule to CxA so that CxA may witness Testing and Start-Up activities if desired.

9. Subcontractors complete testing (e.g. duct and piping pressure testing, piping flushing, etc.) as required by Division 22, 23, and 26 specifications. Subcontractors compile copies of completed testing documentation in the Start-Up Plan and submit to CxA for verification of completion of testing activities prior to Functional Performance Tests.

10. CxA conducts a Commissioning Functional Testing Schedule Meeting with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule.

11. Subcontractors perform Start-Up and Initial Checkout per the Start-Up Plan documentation and checklists. Subcontractors assemble completed Start-Up Plan documentation and submit to CxA for verification of completion of Start-Up activities prior to Functional Performance Tests.

12. Controls Contractor sets up required BAS System trending and reporting and submits trend data to CxA for review.

13. Functional Performance Tests are executed by Subcontractors, under supervision of and documented by CxA.

14. Items of non-compliance in material, installation or set-up will be corrected at Subcontractor expense.

15. CxA issues Final Commissioning Report.

3.02 SYSTEMS TO BE COMMISSIONED

A. CM/Subcontractors will complete Pre-Functional Checklists for 100% of the commissioned equipment (no sampling allowed).

B. The Controls Contractor will provide trending and reporting documentation to the CxA for 100% of the commissioned equipment monitored or controlled by the BAS prior to executing Functional Performance Testing.

C. PLUMBING:

1. Domestic Hot Water Heaters and associated Recirculation Pumps.

2. Any Building Automation System (BAS/EMS) integration or monitoring of commissioned Plumbing equipment/systems.

D. MECHANICAL/HVAC:

1. HVAC systems and equipment including all related controls, and integration with the Building Automation System.

2. All Terminal Boxes and other smaller HVAC equipment - Functional Performance Testing will be completed by utilizing the BAS System to trend the Terminal Boxes for four hours in each operational mode.

3. Any Building Automation System (BAS/EMS) integration or monitoring of commissioned Mechanical/HVAC equipment/systems

E. ELECTRICAL:

1. Lighting Control Systems (Scheduled Controls and Occupancy Sensors) and Daylighting Control Systems. CxA will conduct Functional Performance Testing for a 20% sampling of the

Occupancy Sensor controls. NOTE - Electrical Subcontractor and Lighting Control System Vendor/Authorized Manufacturer Representative shall demonstrate complete operation of Lighting Control Systems indicated separate from and in addition to any other required Owner Demonstrations or Owner Training (i.e. Lighting Control System Vendor/Authorized Manufacturer Representative shall include separate site visit trip for Commissioning testing.

2. Any Building Automation System (BAS/EMS) integration or monitoring of commissioned Electrical equipment/systems.

3.03 RESPONSIBILITIES OF COMMISSIONING TEAM MEMBERS

A. Architect/Engineer (A/E):

1. Document design intent of systems. Respond to any issues developed during the commissioning process that may require clarification of design intent.

B. Commissioning Agent (CxA):

1. Facilitate cooperation of CT in Commissioning work.

2. Provide periodic progress reports of Commissioning status.

3. Review, track and coordinate resolution of non-compliance and deficiencies identified by Commissioning team. Maintain Master Issues Log (MIL), Resolution Log, & Testing Record. Maintain records of all issues submitted by Commissioning team.

4. Identify Commissioning activities for inclusion into the project schedule by the CM.

5. Attend and chair Commissioning team meetings as required.

6. Develop Commissioning Plan including project specific Pre-Functional Checklists and Functional Performance Test procedures. A single overall Commissioning Plan will be prepared for all phases of work.

7. Conduct initial Commissioning Kick-Off Meeting to review Cx Plan and responsibilities of each member of the CT.

8. Review final A/E approved shop drawings for equipment to be commissioned and modify Cx Plan if required.

9. Review A/E approved control submittal sequences of operation and update Commissioning Plan Functional Performance Tests (FPTs) if required. Work with Contractors and AE until sufficient clarity has been obtained, in writing, to update Commissioning Plan FPTs.

10. Attend construction meetings. CxA will attend a total of six (6) meetings via teleconference or web conference.

11. Conduct one (1) site visit prior to Functional Performance Testing to review commissioned systems installations and sample verify CM/Subcontractor completed PFCs. Provide a summary "Site Visit Report" following site visit.

12. Conduct a Commissioning Functional Testing Schedule Meeting with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule.

13. Review final executed Start-Up Plan systems testing and equipment Start-Up documentation completed by Subcontractors.

14. Conduct Trend-Logging Plan Meeting with CM/Controls Contractor prior to Functional Testing to coordinate BAS trending requirements. Trend-Logging Plan Meeting will coordinate and finalize:

    a. System points to be monitored.

    b. Frequency/interval of monitoring for each point.

    c. Trend data output file format, presentation, and data-transfer requirements.

15. Review the final Test and Balance report prior to Functional Performance Testing to verify systems readiness for testing.

16. Review BAS Control Contractor trending prior to Functional Performance Testing to verify systems readiness for testing.

17. Witness FPTs. CxA will conduct three (3) multi-day site visits to complete Functional Performance Testing. Document test results and recommend system for acceptance. Provide a summary "Site Visit Report" following FPT site visits.

18. Provide Final Commissioning Report, summarizing final disposition of building systems after Functional Performance Testing.

C. Construction Manager (CM):

1. The CM leads the commissioning process for the construction team and facilitates cooperation of Subcontractors in executing and completing the commissioning work. In addition to the specific CM commissioning roles and responsibilities specified herein, the CM is ultimately responsible for ensuring that the Subcontractor commissioning roles and responsibilities given in other Sections of this specification are executed and completed as specified.

2. Coordinate and schedule all commissioning activities with CxA, UAMS, and Construction Team. Ensures participation of Construction Team during commissioning activities.

3. Ensures resolution of non-compliance and deficiencies of construction related items identified by CxA. Insures Cx Database Master Issues Log (MIL) is updated by Subcontractors to reflect deficiency item corrections for CxA verification. Updates to Cx Database regarding corrections

of deficiencies shall be made within two working days of completion of deficiency correction work.

4. Notifies CxA of completion of CM/Subcontractor Commissioning Activities (e.g. deficiency corrections, Start-Up completion, readiness for Functional Performance Testing, etc.) via Cx Database. Updates to Cx Database regarding status of Commissioning activities shall be made within two working days of activity completion.

5. Review Commissioning Plan, Pre-Functional Checklists, and FPT procedures.

6. Attend Commissioning Kick-Off Meeting and other Commissioning Team Meetings.

7. Assist CT with developing a comprehensive Commissioning schedule.

8. Incorporate Commissioning activities into the construction schedule.

9. Periodically update Commissioning activities in the construction schedule.

10. Submit copies of final A/E approved submittal data for all commissioned equipment to CxA for commissioning purposes.

11. Oversee development of equipment Start-Up Plan by Subcontractor and execution of equipment Start-Up checks by Subcontractor/Vendors.

    a. Ensure equipment Start-Up Plan is developed and contains forms for all required Testing and Start-Up activities.

    b. With Subcontractors, develop overall schedule of Testing and Start-Up activities. Submit final Testing and Start-Up schedule to CxA 30 days prior to start of any such activities to allow CxA to schedule site visit trips to witness activities if desired.

    c. Insure final executed Start-Up Plan is submitted to CxA prior to start of Functional Performance Testing. Insure final executed Start-Up plan is organized and contains all documentation required by this specification before submitting to CxA.

12. Attend the Commissioning Functional Testing Schedule Meeting conducted by CxA with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule. Update the Master Construction Schedule to include all Functional Performance Testing activities.

13. Assures CxA that equipment and systems are ready for Functional Performance Testing. Verifies that the following activities are completed, and documentation submitted to CxA as a prerequisite for Functional Performance Testing:

    a. Subcontractors complete PFCs. PFCs are 100% complete in Cx Database.

    b. All deficiency items noted by CxA prior to Functional Performance Testing are corrected by Subcontractors and MIL is updated accordingly.

c. Executed Start-Up Plan electronic PDF files submitted to CxA including:

1) All equipment/systems testing documents completed by Subcontractors.

2) All equipment/systems Start-Up documents completed by Subcontractors/Vendors.

3) All Control System Start-Up documentation completed by Controls Contractor.

4) Maintenance logs of all interim maintenance tasks performed by Subcontractors/Vendors on all equipment from initial Start-Up through final Owner acceptance, so warranties are not void.

d. Attend Trend-Logging Plan Meeting with CxA and Controls Contractor. Verify trending data is e-mailed to the CxA for review a minimum of two weeks prior to the start of Functional Performance Testing.

e. Submit hard-copy Commissioning Plan Functional Performance Test checklists signed and dated by BAS Contractor to CxA for review prior to start of Functional Testing (to verify BAS Contractor has thoroughly checked all FPTs prior to CxA witnessing FPTs).

f. Final Test and Balance Report is submitted to CxA for review.

14. Attend and participate in Cx Functional Performance Testing as required to insure Subcontractor and Equipment Vendor participation and completion of signing and dating maintenance logs for each item of equipment. Submit maintenance log documentation in final executed Start-Up Plan electronic PDF files to CxA prior to start of Functional Performance Testing.

13. Ensure installation work is complete, is in compliance with Contract Documents and is ready for Functional Performance Testing.

a. Verify PFCs are 100% complete in Cx Database.

b. Verify all deficiency items noted by CxA prior to Functional Performance Testing are corrected and deficiency item status is updated in Cx Database. Deficiency item status updates should be made within two days of completion of corrective work.

c. Verify Start-Up Plan electronic PDF files are forwarded to CM/CxA.

d. Notify CT that equipment and systems are ready for Functional Performance Testing. 14. Execute FPTs developed by CxA as described in contract documents and Commissioning Plan. FPT test results will be documented by CxA.

15. As part of the FPTs, the Electrical Subcontractor and Lighting Control System Vendor/Authorized Manufacturer Representative shall demonstrate complete operation of Lighting Control Systems indicated separate from and in addition to any other required Owner Demonstrations or Owner Training (i.e. Lighting Control System Vendor/Authorized Manufacturer Representative shall include separate site visit trip for Commissioning testing).

16. Provide certified and calibrated instrumentation required to take measurements of system and equipment performance during Functional Performance Testing.

17. Correct deficiencies identified during Functional Performance Testing.

E. Building Automation System (BAS) Contractor:

1. Review Commissioning Plan, Pre-Functional Checklists, and FPT procedures.

2. Correct deficiencies of construction related items identified by CxA. Update Cx Database to reflect deficiency item corrections for CxA verification. Updates to Cx Database regarding corrections of deficiencies shall be made within two working days of completion of deficiency correction work.

3. Notify CxA of completion of Commissioning Activities (e.g. deficiency corrections, Start-Up completion, readiness for Functional Performance Testing, etc.) via Cx Database. Updates to Cx Database regarding status of Commissioning activities shall be made within two working days of activity completion.

4. Attend Commissioning Kick-Off Meeting and other Commissioning Team Meetings.

5. Completely install and thoroughly inspect Start-Up, test, adjust, calibrate and document systems and equipment under Building Automation/Controls Contract.

6. Complete PFCs in Cx Database as control work is completed.

7. Provide laptop computer, software and training to accommodate TAB Contractor in system balancing.

8. Maintain database of control parameters submitted by TAB Contractor subsequent to field adjustments and measurements.

9. Submit schedule of Control System Start-Up activities to CxA 30 days prior to beginning any Control System Start-Up work to allow CxA to witness Control Systems Start-Up work if desired.

10. Maintain comprehensive records of all Control System Start-Up records including but not limited to system calibration checkout records and point-to-point checklists. Submit completed Start-Up documentation in final executed Start-Up Plan electronic PDF files to CxA prior to start of Functional Performance Testing.

11. Attend the Commissioning Functional Testing Schedule Meeting conducted by CxA with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule. Update the Master Construction Schedule to include all Functional Performance Testing activities.

12. Provide BAS trending data for all commissioned systems to the CxA for review prior to FPTs. The complete cost for the Control Contractor to set up ALL required trending and reporting shall be included. Attend CxA Trend-Logging Plan Meeting with CM prior to Functional Testing to

coordinate BAS trending requirements. Trend-Logging Plan Meeting will coordinate and finalize:

a. System points to be trended and frequency/interval of trending for each point. Examples of typical equipment trending points/frequencies are included in a Table at the end of this specification. The final list of points to be trended will be furnished by the CxA to the Controls Contractor after the Controls/Building Automation System submittal has been reviewed and approved by the A/E.

b. Trend data output file format (CSV or XLS files), presentation, and data-transfer requirements.

13. Ensure installation work is complete, is in compliance with Contract Documents, and is ready for Functional Performance Testing.

a. Verify BAS Control related PFC items are 100% complete in Cx Database.

b. Verify all deficiency items noted by CxA prior to Functional Performance Testing are corrected and deficiency item status is updated in Cx Database. Deficiency item status updates should be made within two days of completion of corrective work.

c. Verify Start-Up Plan electronic PDF files are forwarded to CM/CxA.

d. Notify CT that equipment and systems are ready for Functional Performance Testing.

e. Submit executed copies of the Commissioning Functional Performance Tests to CxA for review prior to start of Functional Performance Testing. The executed copies shall be signed and dated by the Control Contractor technician directly responsible for verification of the control sequence or system operation. The purpose of this process is to document that the Control Contractor has tested and verified each sequence prior to the CxA witnessing the Functional Performance Testing.

14. Submit two weeks of operating trend data to CxA for review to assess the readiness of the specific system to begin on-site Functional Testing. BAS trend data should be submitted two weeks prior to anticipated start of FPT.15. Provide instrumentation, computer, software, and communication resources necessary to demonstrate total operation of building systems and control system equipment during Functional Performance Testing.

16. Provide on-site technician skilled in software programming and hardware operation to exercise sequences of operation and to correct control deficiencies identified during Functional Performance Testing.

17. Correct BAS system deficiency issues identified during CxA FPT.

F. Test, Adjust and Balance (TAB) Contractor:

1. Review Commissioning Plan, Pre-Functional Checklists, and FPT procedures.

2. Correct deficiencies of construction related items identified by CxA. Update Cx Database to reflect deficiency item corrections for CxA verification. Updates to Cx Database regarding

corrections of deficiencies shall be made within two working days of completion of deficiency correction work.

3. Notify CxA of completion of Commissioning Activities (e.g. deficiency corrections, Start-Up completion, readiness for Functional Performance Testing, etc.) via Cx Database. Updates to Cx Database regarding status of Commissioning activities shall be made within two working days of activity completion.

4. Attend Commissioning Kick-Off Meeting and other Commissioning Team Meetings.

5. Cooperate with CC with execution of required work.

6. Attend the Commissioning Functional Testing Schedule Meeting conducted by CxA with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule. Update the Master Construction Schedule to include all Functional Performance Testing activities.

7. Coordinate schedule for all TAB activities with CxA. Provide CxA with final schedule for all TAB activities 30 days prior to starting TAB work to allow CxA to schedule site visits to witness TAB work and readings if desired.

8. Submit copy of final TAB report to CxA for review prior to start of Functional Performance Testing for CxA review to assess readiness for FPTs.9. Rebalance deficient areas identified during Commissioning.10. Provide on-site technician and equipment, as necessary, skilled in TAB procedures to provide verification of equipment and system performance and to correct any TAB deficiencies identified during Functional Performance Testing.

3.04 COMMISSIONING TEAM (CT) MEETINGS

A. CT meetings will be held periodically as determined by CxA with frequency increasing as construction advances and systems become operational. Attendance is mandatory. CxA will record minutes and attendance. CxA will chair CT Meetings.

B. Discussions held in CT meetings shall include, but not be limited to system/equipment Start-Up, progress, scheduling, testing, documentation, deficiencies and problem resolution.

3.05 REPORTING

A. CxA will provide regular status reports to CM and Owner, with increasing frequency as construction and Commissioning progresses.

B. CxA will regularly communicate with members of Commissioning team, keeping them apprised of Commissioning progress.

C. CxA shall submit non-compliance and deficiency reports to Owner and CM.

D. CxA shall provide a Final Commissioning Report to Owner.

3.06 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. CM/Subcontractors will complete the Pre-Functional Checklists in the Cx Database.

B. CM/Subcontractors will complete the PFCs in phases as the work is completed in the field (e.g. setting equipment, piping equipment, insulating it, making up electrical connections, etc.). The intent is for the CM/Subcontractors to complete the PFCs in the Cx Database as the work is being completed - not to wait until the end of the installation to complete the PFCs.

C. CM/Subcontractor shall provide necessary field personnel to compete the PFCs in a timely manner concurrent with work progress. CxA will make one (1) site visit prior to Functional Performance Testing to review the commissioned systems installations and sample verify the CM/Subcontractor completed PFCs. The CxA will randomly select PFCs from each commissioned systems for verification. PFC completion status not matching work completion observed in the field will be noted as a deficiency issue by the CxA.

D. Any deficiency issues noted will be included and tracked in the Master Issues Log.

3.07 MASTER ISSUES LOG (MIL)

A. Commissioning Issues will be tracked from initial notice by CxA through correction via the Cx Database as follows:

1. Open Issue:

a. Issues noted by the CxA during periodic site visits will be included to the Cx Database Master Issues Log (MIL) for each building.

2. Recheck Issue:

a. The Subcontractors shall correct the deficiency items and notify the CxA when the items are corrected and ready for CxA verification by updating the deficiency item status from “Open” to “Recheck” in the “Building Start:” database. CxA does not recheck issues until they have been noted ready to be reviewed on the Cx Database MIL by the Subcontractor that corrected the issue.

3. Closed Issue:

a. The CxA will verify the correction and update the item status from “Recheck” to “Fixed” in the Cx Database.

B. Costs for CxA to reverify any Issue marked by the Subcontractor for CxA recheck and found to be incomplete will be back-charged to the CM (see paragraphs below for CxA costs).

3.08 START-UP AND INITIAL CHECKOUT

A. CM/Subcontractors shall schedule all required Systems Testing and Equipment Start-Up with Commissioning Team. CM/Subcontractors shall execute Systems Testing and Equipment/Systems Start-Up per the Start-Up Plan.

B. CM/Subcontractor shall submit final schedule of Testing and Start-Up activities to CxA 30 days prior to any testing or Start-Up activity to allow CxA to witness if desired.

C. CM/Subcontractor shall execute equipment/systems Testing and Start-Up per Start-Up Plan, document results and compile/organize all Start-Up Plan documentation into electronic PDF files (searchable from Table of Contents to each documentation item).

D. CM/Subcontractor forward copy of completed Start-Up Plan PDF files to CxA for review to verify completion of Start-Up activities. Executed Start-Up Plan PDF files must be submitted to CxA prior to start of Functional Testing.

E. CM/Subcontractors shall clearly list outstanding items or Testing/Start-Up activities that are not completed successfully. Updates to Cx Database regarding corrections of any Testing and Start-Up deficiency issues shall be made within two working days of completion of retesting work.

F. Subcontractors shall submit an updated Start-Up report and Statement of Correction on any incomplete or non-compliance report.

G. Any Testing or Start-Up activity marked as completed which is later found to be incomplete and causes re-verification work by CxA, delays during Functional Performance Testing, or retesting will be back-charged to the CM (see paragraphs below for CxA costs).

3.09 BUILDING AUTOMATION SYSTEM (BAS) TREND DATA

A. Objectives and Scope:

1. Mechanical, Plumbing, and Electrical Systems operation will be monitored and analyzed by the CxA utilizing trend data provided from the Building Automation System.

B. Construction Phase – Cx FPT Readiness:

1. BAS Trend Data will be utilized prior to Functional Performance Testing in order to gauge the readiness of the systems to be tested.

2. At least 2 weeks prior to the scheduled start of Functional Testing the BAS Contractor shall have e-mailed two weeks of operating data to the CxA.

3. The CxA shall review the data to assess the readiness of the specific system to begin on-site Functional Testing.

4. The CxA shall notify the project team of any deficiencies identified by the trend data analysis that would need to be addressed prior to beginning Functional Testing.

3.10 FUNCTIONAL PERFORMANCE TESTING

A. Objectives and Scope:

1. The objective of Functional Performance Testing is to demonstrate each system is operating according to documented design intent and Contract Documents. Functional Performance Testing facilitates bringing systems from a state of Substantial Completion to full dynamic operation. Additionally, during Functional Performance Testing, areas of deficient performance are identified and corrected, improving operation and functioning of systems.

2. Each system shall be operated through all modes of operation (occupied, unoccupied, warm-up, cool-down, etc.) where there is a specified system response. Verifying each sequence in the sequences of operation is required.

3. Functional Performance Testing is separate from and in addition to any other Start-Up, testing, demonstration or contractor commissioning required by the project specifications.

4. The CxA will document the Functional Performance Testing utilizing the Cx Database.

B. Initial Control Systems Checkout:

1. The control systems must be verified for correct operation by the Control System Subcontractor prior to the CxA witnessing and documenting the Functional Performance Tests . The CxA Functional Performance Tests are intended to document completion of the Control System and proper operation of the Commissioned Systems. The CxA Functional Performance Tests are not intended to serve as a "Quality Control" measure or "Punch List" for the Construction Manager, Controls Contractor or other Subcontractor. The CxA Functional Performance Tests are not intended to serve as "Beta" testing for the Control Systems.

2. The Control Systems Subcontractor shall sign/initial and date a copy of the Cx Plan FPT forms prior to verification by CxA. Only individuals having direct knowledge that a line item task or sequence of operation was performed or checked will initial or check that item off. The Control Systems Subcontractor shall list any FPT sequences or items not completed successfully utilizing the notes Section of the FPT form. These notes shall clearly indicate why the item or sequence was not completed or operated as indicated on the FPT form.

3. The intent of this process is for the Control Systems Subcontractor to physically check and verify proper equipment and integrated systems operation for all operational sequences prior to the CxA witnessing and documenting the actual Functional Performance Testing.

C. Coordination and Scheduling:

1. Prior to equipment Start-Up, CxA will conduct a Commissioning Functional Testing Schedule Meeting with the Commissioning Team to establish a coordinated approach to the integration of the Functional Performance Testing activities within the Master Construction Schedule. The CM will update the Master Construction Schedule to include all Functional Performance Testing activities.

2. CM will provide sufficient notice to CxA regarding completion schedule for equipment and systems. CM will schedule Functional Performance Tests with CT. CxA shall witness and document functional testing of equipment and systems. Subcontractor shall execute tests under direction of CxA.

3. CM must allow sufficient time in the Construction Schedule to complete the Functional Performance Testing prior to Owner move-in/occupancy. This includes completing the commissioned systems installations, Testing, Start-Up, and all prerequisites required for Functional Performance Testing. Time and expenses for CxA to complete Functional Performance Testing during Owner move-in or after Owner occupancy will be considered Additional Services to be paid by the CM.

4. All Commissioning FPTs must be completed separate from and prior to any required Code Authority or Inspector testing.

5. Functional Performance Tests are integrated systems tests. For example, the Fire Alarm System must be complete and ready for operation to test the AHU Fire Alarm shutdown sequence. All equipment and systems associated with a Functional Performance Test must be complete and ready for testing.

6. In general, the Functional Performance Testing will be organized/scheduled based on the following hierarchy:

    a. Project completion. Some areas of the building may be complete before other areas. Priority will be given to these area systems assuming they can be grouped together for integrated systems testing.

    b. Integrated systems. In general, the testing will be organized into groups of integrated systems from larger systems down to smaller systems (e.g. chilled water system, air handling system, terminal units, etc.).

    c. Systems with limited integration and “stand alone” systems (e.g. unit heater or fan only being monitored by the building control system).

7. Functional Performance Tests will be grouped together to allow testing to be conducted over weekly testing periods to maximize testing efficiencies. Single systems testing spread out over multiple testing weeks will not be allowed. In general, the testing will begin on Monday and end on Friday afternoon. The actual testing hours will be coordinated with the CM/Subcontractors based on the amount of testing work to be completed during that week. CM/Subcontractors should be prepared to work from 8:00AM to 5:00PM each day to complete the testing for that weekly period.

8. Some systems may require testing after normal working hours (e.g. Lighting Controls, AHU Fire Alarm Shutdown, etc.) to avoid conflicts with ongoing work or adjacent building operations. This testing will be scheduled for evenings (Monday – Thursday) or early mornings (Tuesday – Friday). Weekend testing will only be allowed if agreed upon by CT in advance.

D. Prerequisites for Functional Performance Testing:

1. Pre-Functional Checklists must be 100% complete in Cx Database - including any deficiency corrections noted from CxA sample verifications - as a prerequisite to scheduling Functional Performance Tests.

2. The CM/Subcontractors must submit the fully executed Start-Up Plan electronic PDF files including all equipment and systems testing documentation (e.g. duct and piping pressure testing, cleaning/flushing documentation, etc.), and all executed start up and initial check-out documentation as a prerequisite to
scheduling Functional Performance Tests.

3. The TAB Subcontractor shall complete all test and balance work and submit Final Test and Balance Report for review by A/E and CxA prior to start of Commissioning Functional Testing. A/E shall review Final Test and Balance Report for acceptance. CxA review of Final TAB Report is cursory (not for acceptance) and is primarily intended to ensure that the equipment and systems
are ready to be functionally tested.

4. The CM/Control Contractor must submit all control systems Start-Up and initial checkout documentation (including point-to-point verifications, etc.) in the Start-Up Plan as a prerequisite to scheduling Functional Performance Tests.

5. The CM/Control Contractor must submit executed copies of the Commissioning Functional Performance Tests (signed and dated by the Control Contractor technician directly responsible for verification of the control sequence or system operation) to the CxA as a prerequisite to scheduling Functional Performance Tests (to show that the Control Contractor has tested and verified each sequence prior to CxA witnessing the Functional Performance Tests).

6. The CM/BAS Control Contractor must complete BAS system trending data set-up and reporting and submit two weeks of operating data (either automatically or manually) for CxA review to assess the readiness of the specific system to begin on-site Functional Testing. Operating data must be submitted at least two weeks prior to anticipated start of Functional Testing.7. The BAS System network and front end must be complete and operational. BAS Graphics must be complete.

3.11 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation:

1. CxA will witness and document results of FPT utilizing Cx Database. FPTs are made available to the Commissioning Team in Cx Database for review and approval prior to testing. CxA will include the executed FPTs in the Final Commissioning Report.

B. Non-Conformance:

1. CxA will record results of Functional Performance Testing. Deficiency or Non-Conformance Issues will be noted and reported to CM and Owner in the Cx Database Master Issues Log (MIL).

2. Corrections of minor deficiencies identified may be made during tests at discretion of CxA. In such cases, deficiency and resolution will be documented in Cx Database FPT.

3. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. CxA shall not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.

4. Deficiency and Non-Conformance Issues are handled in the following manner:

   a. When there is no dispute on Deficiency Issue and Subcontractor accepts responsibility for remedial action:

      1) CxA documents Deficiency Issue and Subcontractors response and intentions in Cx Database MIL and they go on to another test or sequence.

      2) All issues are made available to CT via Cx Database MIL and written Cx Site Visit Reports.

      3) Subcontractor corrects deficiency and updates Issue status to “Recheck” in Cx Database MIL.

      4) CM reschedules test with Subcontractor.

      5) CxA witnesses retesting and documents results. Corrected issues will be updated in Cx Database MIL to “Fixed”.

      6) See paragraphs below for CxA costs for retesting and reverification work

   b. When there is a dispute about a Deficiency Issue, regarding whether it is a deficiency or who is responsible:

      1) CxA documents Deficiency Issue and Subcontractors response and intentions in Cx Database MIL and they go on to another test or sequence.

      2) All issues are made available to CT via Cx Database MIL and written Cx Site Visit Reports.

      3) CM facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority is with A/E. Final acceptance authority is with the Owner.

4) CM documents resolution process.

5) Once interpretation and resolution has been decided, appropriate party corrects deficiency and updates Issue status to "Recheck in Cx Database MIL.

6) CM reschedules test and test is repeated until satisfactory performance is achieved.

7) CxA witnesses retesting and documents results. Corrected issues will be updated in Cx Database MIL to "Fixed".

8) See paragraphs below for CxA costs for retesting and reverification work.

C. Costs for CxA MIL Verifications and Retesting:

1. Cost for Subcontractor to correct and retest any PFC or FPT deficiency item, if they are responsible for deficiency, will be theirs. If Subcontractor is not responsible, cost recovery for retesting will be negotiated with CM.

2. CxA labor and expenses for any of the following work will be back-charged to the CM at a cost of $2500 per man-day. The CM must pay retesting costs to CxA in advance for CxA to schedule retesting or reverification site visits.

a. Excessive Deficiency Issue Verifications (for excessive/repeated issues).

b. Any reverification of a Deficiency Issue when the Issue is marked as corrected by the Subcontractor and found to remain deficient by CxA on verification.

c. Delays during Functional Performance Testing caused by excessive or repeated testing failures.

d. Functional Performance Test Retesting for any reason.

e. Any FPT MIL Issue Verifications or Retesting.

D. Costs for Functional Performance Test Additional Services:

1. Cost for CM/Subcontractor to complete Functional Performance Testing Additional Services will be theirs.

2. Additional Services for CxA to complete any Functional Performance Testing during Owner move-in or after Owner occupancy (regardless of whether the testing was attempted prior to that point or not) will be paid for by the CM at a cost of $2500 per man-day. CM must pay testing costs to CxA in advance for CxA to schedule testing site visits during Owner move-in or after Owner occupancy.

E. Approval:

1. CxA notes each satisfactorily demonstrated function on test form. CxA, A/E and Owner provide formal approval of FPT. CxA recommends acceptance of each test to Owner. The Owner gives final approval, providing a signature to CM and Subcontractor.

END OF SECTION 019113

Note: Sample Pre-Functional Checklists, Sample Functional Performance Tests, and Table of Sample BAS Trend Data Points by System Type follow.

Sample HVAC Pre-Functional Checklist

PROJECT:
LOCATION:

SYSTEM/UNIT: HVAC Equipment/ AHU

Tested By:
Date:

Model Verification - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Specified Manufacturer				
2	Installed Manufacturer				
3	Specified Model #				
4	Installed Model #				
5	Serial #				
6	Specified Airflow				
7	Specified Static Pressure				

General - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Inspection and Access doors are operable				
2	Casing Undamaged				
3	Equipment has been cleaned and finish touched up if necessary.				
4	Manufacturer's required maintenance clearance provided for service.		23 05 [illegible] 1.8 E		
5	Specified unit mounting requirements		Schedule Note 10		
6	Verify unit is mounted per plans and specs		Schedule Note 10		
7	Specified access doors		Schedule Note 4		
8	Verify access doors are provided per plans and specs		Schedule Note 4		
9	Access doors are installed so no air leaks through door				
10	Access doors open against air pressure				
11	Specified lights are provided per plans and specs		Schedule Note 5		
12	Verify lights are installed in locations per plans and specs		Schedule Note 5		
13	4" housekeeping pad is provided under all floor mounted equipment		23 05 48 3.4 G		
14	Flexible pipe connectors are installed on all equipment supported by vibration isolation		23 05 48 3.4 L		

Accessories - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Specified accessories are provided (1)		Schedule Note 12		
2	Verify accessories are provided (1)		Schedule Note 12		
3	Specified accessories are provided (2)		Schedule Note 11		
4	Verify accessories are provided (2)		Schedule Note 11		
5	UV lights are factory installed downstream of cooling coils		Schedule Note 16		

Sample

Sample HVAC Pre-Functional Checklist

PROJECT:
LOCATION:

SYSTEM/UNIT: HVAC Equipment- AHU

Tested By:
Date:

Ductwork - HVAC Equipment - AHU

	Verification	Response	Notes	By	Date/Time
1	Ductwork is connected to unit with flexible connections		Schedule Note 19		
2	Duct installation is complete				
3	Access doors installed and labeled at fire / smoke dampers, fire dampers, and smoke detectors		23 31 13 3.1 E		

Controls - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Return duct smoke detector is installed in return duct		Schedule Note 1		
2	Supply duct smoke detector is installed after supply fan		Schedule Note 13		
3	Specified return air sensors are installed per the controls schematic		M06-02 Detail C3		
4	Verify return air sensors are installed per the controls schematic		M06-02 Detail C3		
5	Specified mixed air sensors are installed per the controls schematic		M06-02 Detail C3		
6	Verify mixed air sensors are installed per the controls schematic		M06-02 Detail C3		
7	Specified discharge air sensors are installed per the controls schematic		M06-02 Detail C3		
8	Verify discharge air sensors are installed per the controls schematic		M06-02 Detail C3		
9	Specified automatic dampers are installed per the controls schematic		M06-02 Detail C3		
10	Verify automatic dampers are installed per the controls schematic				

Sample

Labeling - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Permanently fasten labels are on each major item of mechanical equipment. Labels are located in accessible and visible areas.		23 05 53 2.3 A		
2	Duct is labeled with contents and flow direction		23 05 53 2.3 C		

Insulation - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Specified Air Duct Insulation requirements:		23 07 13 4.1 - EXPOSED: 2" Rigid Fiberglass Board; CONCEALED: 2" Flexible Fiberglass with Vapor Barrier		
2	Verify Air Duct Insulation requirements:		23 07 13 4.1		

Startup Mechanical - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	Contractor's executed startup procedures haves been submitted for review				

Sample HVAC Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: AHU

Tested By:
Date:

1.01 Pre-test Set points & Conditions - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	RECOR D: OA Flow				
2	RECOR D: OA Damper Command				
3	RECOR D: RA Temperature °F				
4	RECORD: RA Humidity %RH				
5	RECOR D: CHW Valve Status/Command				
6	RECORD: CHW Coil LAT				
7	RECORD: VFD - 1 Status/Command				
8	RECORD: VFD - 1 Speed %				
9	RECORD: VFD - 2 Status/Command				
10	RECORD: VFD - 2 Speed %				
11	RECORD: SA Temperature Setpoint/Actual	°F			
12	RECORD: SA Flow Setpoint/Actual				
13	RECORD: Interlocked Exhaust Fan(s) Status/Command				
14	RECORD: Coil DP Setpoint/Actual				
15	RECORD: 2/3 Duct Static Pressure				

1.02 Post-test Set points - HVAC Equipment/ AHU

	Verification	Response	Notes	By	Date/Time
1	RESET: Upon completion of test reset set points to pre-test set point values				

Sample

Sample HVAC Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: HVAC Equipment/AHU

Tested By:
Date:

2.01 Unit - On - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1 **-1x**	TEST PROCEDURE: Unit is commanded on via building BMS				
2	EXPECTED RESPONSE: Fire/Smoke Dampers are fully opened				
3	EXPECTED RESPONSE: Supply fan is energized and runs continuously during unit operation				
4	EXPECTED RESPONSE: Interlocked Exhaust Fan(s) is energized and runs continuously during unit operation				
5	EXPECTED RESPONSE: VFD(s) modulates to maintain constant flow as filters get loaded				
6	EXPECTED RESPONSE: OA damper opens to minimum airflow position				
7	EXPECTED RESPONSE: RA damper opens fully				
8	EXPECTED RESPONSE: OA damper modulates to maintain OA flow setpoint				
9	EXPECTED RESPONSE: Cooling coil valve modulates to maintain LAT setpoint (50°F, adj.)				
10	VERIFY: Supply fan minimum runtime is programmed				

2.02 Cooling Coil Control - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate OA temp > 45°F				
2	EXPECTED RESPONSE: Cooling Coil is enabled				
3	EXPECTED RESPONSE: Cooling coil control valve modulates to maintain LAT setpoint of 50°F (adj.)				

Sample

Sample HVAC Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: HVAC Equipment/AHU

Tested By:
Date:

2.03 Supply Air Reset - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate return air temperature > return air high limit				
2	EXPECTED RESPONSE: Supply air temperature setpoint is reset downward				
3	RECORD: RA Temperature High Limit Setpoint	°F			
4	RECORD: Supply Air Temperature Setpoint/Actual	°F			
5	TEST PROCEDURE: Simulate return air temperature < return air low limit				
6	EXPECTED RESPONSE: Supply air temperature setpoint is reset upward				
7	RECORD: RA Temperature Low Limit Setpoint	°F			
8	RECORD: Supply Air Temperature Setpoint/Actual	°F			

2.04 Unit - Off - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Unit is commanded to shut down via building BMS				
2	EXPECTED RESPONSE: OA damper closes				
3	EXPECTED RESPONSE: CHW Coil opens				
4	EXPECTED RESPONSE: Supply fan deenergizes				
5	EXPECTED RESPONSE: Interlocked exhaust fan(s) deenergizes				

3.01 High Space Temperature Alarm - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate space temperature greater than the cooling setpoint by a "user defined amount"				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

3.02 Low Space Temperature Alarm - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate space temperature lower than the cooling setpoint by a "user defined amount"				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

Sample

Sample HVAC Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: HVAC Equipment/AHU

Tested By:
Date:

3.03 High Return Air Humidity - AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate RA humidity > 70% (adj.)				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

3.04 Low Return Air Humidity - AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate RA humidity < 35% (adj.)				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

3.05 Supply Fan Failure - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate supply fan status does not match command				
2	VERIFY: Remaining supply fan(s) ramp up to maintain supply airflow setpoint				
3	EXPECTED RESPONSE: Alarm is sent to BMS				
4	TEST PROCEDURE: Simulate supply fan runtime exceeded				
5	EXPECTED RESPONSE: Alarm is sent to BMS				
6	RECORD: Runtime Alarm Setpoint				

3.06 Pre Filter DP Alarm - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate DP across pre filter > pre filter DP setpoint				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

3.07 Final Filter DP Alarm - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate DP across final filter > final filter DP setpoint				
2	EXPECTED RESPONSE: Alarm is sent to BMS				

3.08 Smoke/Fire Detection Alarm - HVAC Equipment/AHU

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate smoke detected/emergency shutdown signal				
2	EXPECTED RESPONSE: Unit shuts down according to shutdown sequence				
3	EXPECTED RESPONSE: Alarm is sent to BMS				

Sample

Sample Plumbing Systems Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: Domestic Hot Water System

1.00 Sample FPT - Domestic Hot Water System

	Verification	Response	Notes	By	Date/Time
1	Sample FPT				

1.02 Pre-test Setpoints & Conditions - Domestic Hot Water System

	Verification	Response	Notes	By	Date/Time
1	RECORD: WH-A Status				
2	RECORD: WH-B Status				
3	RECORD: Recirculation Pump A Status				
4	RECORD: Recirculation Pump B Status				
5	RECORD: DHWR Temperature				
6	RECORD: DHWS Leaving WH-A Temperature Setpoint/Actual				
7	RECORD: DHWS Leaving WH-B Temperature Setpoint/Actual				
8	RECORD: WH-A Circulation Pump Status				
9	RECORD: WH-B Circulation Pump Status				
10	RECORD: WH-A Temperature Control Valve Position (If available)				
11	RECORD: WH-B Temperature Control Valve Position (If available)				
12	RECORD: HW Temperature to HX				
13	RECORD: HW Temperature Leaving HX				
14	RECORD: Mixing Valve Setpoint/Actual Leaving Water Temperature				

Sample

Sample Plumbing Systems Functional Performance Test

PROJECT:
LOCATION:

2.01 System Enabled - Domestic Hot Water System

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Domestic Water System is enabled				
2	EXPECTED RESPONSE: Domestic Water Recirculation Pumps are energized manually				
3	EXPECTED RESPONSE: Active Water Heater's circulation pump is energized				
4	EXPECTED RESPONSE: Water Heaters Temperature Control Valve modulates to maintain the LWT Setpoint				
5	EXPECTED RESPONSE: Mixing Valve maintains setpoint				
6	TEST PROCEDURE: Water Heater LWT is above or below setpoint				
7	EXPECTED RESPONSE: Water Heaters Temperature Control Valve modulates to maintain the LWT Setpoint				
8	RECORD: DHWS Leaving WH-A Temperature Setpoint/Actual				
9	RECORD: DHWS Leaving WH-B Temperature Setpoint/Actual				
10	EXPECTED RESPONSE: Mixing Valve maintains setpoint				

2.02 System Disabled - Domestic Hot Water System

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Domestic Water System is disabled				
2	EXPECTED RESPONSE: Domestic Water Recirculation Pumps are de-energized manually				
3	EXPECTED RESPONSE: Water Heater's circulation pumps are de-energized				
4	EXPECTED RESPONSE: Water Heaters Temperature Control Valves open to bypass				

3.01 System Alarm - Domestic Hot Water System

	Verification	Response	Notes	By	Date/Time
1	TEST PROCEDURE: Simulate an alarm from the system				
2	EXPECTED RESPONSE: Alarm is sent to BAS				

Sample

Sample Electrical Systems Functional Performance Test

PROJECT:
LOCATION:

SYSTEM/UNIT: Lighting Controls

1.0 Test Procedure: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	VERIFY A minimum of 20% of occupancy sensors are to be functionally tested. Document room tested and results of device tested.				
2	VERIFY by visual response that:				
3	PROCEDURE Device senses space is occupied and turns lights ON.				
4	PROCEDURE Device senses space is un-occupied.				
5	PROCEDURE Device turns lights off after preset time delay. (10-30 minutes)				
6	PROCEDURE Local switch operates properly, if applicable.				
7	PROCEDURE Device location during time of functional testing is indicated below:				

1.1 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	RECORD Devices installed in the following areas were demonstrated to operate, with any issues noted on the MIL. See 'Comments' section for device location.				
2	Level 1				

1.2 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	Level 2				

1.3 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	Level 3				

1.4 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	Level 4				

1.5 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	Level 5				

1.6 Device Location: Occupancy Sensor

	Verification	Response	Notes	By	Date/Time
1	Level 6				

Sample

Sample Electrical Systems Functional Performance Test

PROJECT:
LOCATION:

	Verification	Response	Notes	By	Date/Time
1	VERIFY the following features are provided:				
2	3.5 inch touch screen				
3	On/Off buttons for each group of fixtures				
4	Dimmer for each group of fixtures				
5					

2.1 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	RECORD Device(s) installed in the following areas were demonstrated to operate, with any issues noted on the MIL. See 'Comments' section for additional device location.				
2	Level 1				

2.2 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	Level 2				

2.3 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	Level 3				

2.4 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	Level 4				

2.5 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	Level 5				

2.6 Device Location: Graphic Wall Pod

	Verification	Response	Notes	By	Date/Time
1	Level 6				

Sample

SSRCx
FACILITIES COMMISSIONING

SAMPLE BAS DATA POINT TRENDING / ARCHIVING PLAN

		Equipment ID / Trending Interval (minutes)														
Point Description	Units	Weather Station	Outside Air Handling Unit	Air Handling Unit	Chilled Water System	Condenser Water System	Hot Water System	Air Terminal Unit / Space	Fan Coil Units	Computer Room Air Conditioner	Exhaust Fan	Unit Heater	Electrical Panels	Domestic Water Heating System	Irrigation System	Lighting Control System
Outdoor Air Dry Bulb Temp	F	15														
Outdoor Air Relative Humidity	%RH	15														
SF VFD Power	kWh		15	15												
SF Airflow	CFM		15	15												
SF Airflow Setpoint	CFM		15													
Unit Discharge Air Temp	F		15	15												
Unit DAT Setpoint	F		15	15												
Space Humidity	%RH		15					15		15						
Space Humidity Setpoint	%RH		15					15		15						
Humidifier Valve Position	% Open		15	15												
CHW Return Temp	F		15	15												
CHW Valve Position	% Open		15	15					15	15						
HW Return Temp	F		15	15												
AHU HW Valve Position	% Open		15	15												
Zone Airflow	CFM															
Zone Damper Position	% Open		15													
Zone HW Discharage Air Temp	F		15					15								
Zone HW Valve Position	% Open		15					15	15	15						
Space Temperature	F		15					15	15	15		15				
Space Temperature Active Setpoint	F		15					15	15	15		15				
Occupied Status (Sensor or Schedule)	On/Off							15	15	15						
RF VFD Power	kWh		15	15												
RF Airflow	CFM			15												
Space Differential Static Pressure	in. w.c.			15				15								
Space Differential Static Pressure Setpoint	in. w.c.		15					15								
Outdoor Air Damper Position	% Ope		15													
Outdoor Airflow	CFM		15	15												
Outdoor Airflow Setpoint	C															
Duct Static Pressure	in. w.			15												
Duct Static Pressure Setpoint	in. w.c.			15												
Supply Air CO2	pm															
Space CO2								15								
Space Differential CO2 Setpoint	pp							15								
Bldg Supply Temp					15											
Bldg Supply Temp Setpoint					15											
System Supply Setpoint	F				15	15	15									
System Supply Temp	F				15	15	15							15		
System Return Temp	F				15	15	15									
System Flow	gpm				15	15	15									
System Capacity	MBh				15	15	15									
System Diff Pressure	psi				15	15	15									
System Diff Pressure Setpoint	psi				15	15	15									
Pump VFD Power	kWh				15	15	15									
Chiller CHW Supply Temp	F				15											
Chiller CHW Return Temp	F				15											
Chiller Evaporator Flow	gpm				15											
Chiller Entering CW Temp	F				15											
Chiller Leaving CW Temp	F				15											
Chiller Power (Typical each compressor)	kWh				15											
Cooling Tower VFD Power (Typical each fan)	kWh					15										
Heat Recovery Chiller HW Return Temp	F						15									
Heat Recovery Chiller HW Supply Temp	F						15									
Heat Recovery Chiller HW Supply Temp Setpoint	F						15									
Boiler Status	On/Off						15							15		
Fan Status	On/Off								15	15	15	15				
Pump Status	On/Off													15		
Exhaust Fan VFD Power	kWh										15					
Illuminance	fc															15
Make-up Water Consumption	gpm														15	
Electric Consumption	kWh												15			
Natural Gas Consumption	cu. ft.						15							15		

Sample

Arkansas State University Information and Technology Services (ASU-ITS)
Computer Network Specifications
(Revision 10, 2024 0315)

SECTION 1 – Contractor Requirements

1. Contractors and sub-contractors shall have a minimum of three (3) years experience in the installation of structured cabling systems.
    a. All installers assigned by the contractor or sub-contractor for fiber-optic installation shall have a current Corning Certification.
2. All certifications must be presented to ASU-ITS prior to awarding contract.
3. Contractors and sub-contractors will provide all test equipment used to conduct acceptance tests for Ethernet cabling and fiber-optic installations. Test equipment must be able to generate a physical or digital report of test results.
4. Contractors and sub-contractors will provide all materials, labor, and equipment necessary to install a fully functioning computer network system when terminated to the main and intermediate distribution frames (MDF/IDF) from any end-point network location. These include, but are not limited to, the following: network jacks, wall plates, conduit, wiring, fiber-optic cabling, anchors, hooks, patch panels, racks, and ladder racks. All materials must meet exact ASU-ITS specifications as stated in Section 2 of this document.
5. Contractors and sub-contractors shall warrant against all product and installation defects, and all approved cabling components meet or exceed the requirements of TIA/EIA-568-B and ISAO/IEC 11801, or latest drafts, for a period of one (1) year.
6. All data contractors and sub-contractors must be approved by ASU-ITS before contract is awarded.

SECTION 2 – Equipment

1. Ethernet Network Cable: AdvanceNet M57193B 23-4P UTP-CMP SOL BC CAT6 FEP/FRPVC BLUE JACKET. This is Cat 6, unshielded, twisted pair, blue sheathing cable that is plenum. Plenum rated cables shall be installed regardless if they are installed in air plenums or not. (Anixter p/n CMP-00424MWK-7U-06).
2. J-Hooks:
    a. Maximum fill-50 Cat 6 equal to B-Line J-hook p/n BCH64 (Do not exceed 50% of hook capacity.)
    b. Maximum fill-150 Cat 6 equal to Anixter J-hook p/n 222878 (Do not exceed 50% of hook capacity.)
3. Ladder Racks: Equal to the black, 12” wide Universal Cable Runway and all accessories by Chatsworth Product Incorporated p/n 10250-712.
4. Contractors must supply fasteners compatible with cable support system products. All anchors and fasteners must be attached to building frame.

5. Networking Floor-Mounted Closet Racks: Racks shall be 19” wide EIA & 7’ tall (Chatsworth Product Incorporated p/n 55053-703 or -503) & include Double-Sided Vertical Cable Management (Chatsworth Product Incorporated p/n 13912-703).
6. Networking Wall-Mounted Closet Racks: Chatsworth Product Incorporated p/n 11840-724.
7. Exposed Wiring Covers: All communications/computer wiring to be left exposed in rooms shall be enclosed in Panduit surface raceway system components. Provide Panway Type “TM” raceway products and accessories as required to fully conceal wiring exposed in rooms. Mod-Com compatible. Submit colors for approval. Submit products for approval as equal.
8. Patch Panels: Leviton 132-49255-H24 QuickPort Patch Panel, 24-port, 1U, Black (Empty) (Anixter p/n 204842)
    a. For patch panel ports use: Belden REVConnect 10GX Field Mount Plug, UTP, Metal, Bulk Pack (p/n RVAFPUBK-B24) (Anixter p/n 701077)
9. Outlets: Combination data/communications outlets shall be as follows:
    a. For flush mounted plates, use Belden AX102655 KeyConnect Faceplates 2-Port, with ID Windows, Single Gang, Flush White. (Anixter p/n 371952)
    b. For surface mounted ports use:
        i. Single Port: Belden AX102651 KeyConnect Side Entry Box with Shutter Door 1-Port (Anixter p/n 372307)
        ii. Dual Port: Belden AX102652 KeyConnect Side Entry Box with Shutter Door 2-Port (Anixter p/n 372308)
    c. Color of RJ45 jack shall be orange. Belden REVConnect Category 6+ Modular Jack, T568 A/B, UTP, Orange (p/n RV6MJKUOR-B24) (Anixter p/n 701017). (This is the 24 pack, the single jack has a p/n of RV6MJKUOR-S1 and an Anixter p/n of 700996.)
    d. RJ11 jack shall be CommScope SL Series Jack, CAT 3 (p/n 1375192-1)
    e. Color of RJ11 jack shall match color of faceplate if possible.
    f. Color of the faceplate shall be selected by the Architect.
10. Intra-building Phone/Fax Copper Cable:
    a. Shall be Category 3 Plenum rated.
    b. Siemon p/n S110AWI-50 or equivalent punch down blocks shall be used.
    c. CommScope 25 pair Plenum p/n 760077537 or equivalent shall be used to connect IDFs to MDF. All cables shall be a homerun from the IDFs to MDF.
11. Inter-Building Phone/Fax Copper Cable:
    a. A minimum of (2) 4” conduit between buildings. Conduit must include a pull string. Woven polyester mule tape Neptco p/n WP2500P-3000 or equivalent shall be used. (Anixter p/n 486356).
    b. A minimum 25 pair 24 gauge exchange cable PE89 or equivalent used between buildings. Service to the building POP will be provided by ASU-ITS.

    c. Circatel Building Entrace protectors 25 PR110 in/110 out p/n 1880ENA1/NSC25 or equivalent shall be used at all termination points.
    d. Circatel 3BIE Protector Module, color Black, or equivalent shall be used at all termination points.
    e. All pulls between buildings shall be a homerun back to the centralized MDF or POP. No splicing will be accepted.
12. Fiber-Optic Cable: Single-Mode Corning fiber-optic cable will be used exclusively.
    a. MIC 250 12-strand fiber Corning p/n 012ED8-31301-20 will be used inside buildings to connect IDFs to MDF.
    b. All fiber-optic cables will be a homerun from each IDF to MDF. No splicing will be accepted.
    c. Corning Altos p/n 006EU4-T410D20 single-mode fiber-optic cable will be used for exterior applications. All exterior fiber must be placed in 4" conduit with a pull string. Woven polyester mule tape Neptco p/n WP2500P-3000 or equivalent shall be used. (Anixter p/n 486356).
13. Fiber-Optic Cable Connectors: Corning Unicam ST Single-Mode connector (p/n 95-200-51).
14. Fiber-Optic Closet Connector Housings and Panels:
    a. Closet Connector Housing is Corning p/n CCH-01U.
    b. Closet Connector Panel is Corning p/n CCH-06-19T.
15. E-Phone Stanchions: Red Valcom p/n VE9811-FV.
16. ASU-ITS must approve any requested changes to specifications in writing. ASU-ITS must also approve, in writing, any "equivalent" equipment usage, and must receive all specifications for the "equivalent" equipment from the Contractor. Current valid representatives of ASU-ITS are Tony Marshall, Scott Wheat, Eric Barnett, or Chris Doyle.

SECTION 3 – Procedures

1. All installations must meet or exceed the requirements of TIA/EIA-568-B and ISAO/IEC 11801, or latest drafts.
2. Conduits
    a. Provide factory bends for all elbows on conduit. Do not install more than two (2) 90 degree bends without installing a pullbox. For conduit runs longer than 100', install a pullbox. Where routing is above an accessible ceiling, conduit may be stubbed out from the wall box and turned horizontal above the ceiling and terminated with plastic bushing to protect emerging cable.
    b. Install conduit where cables pass through floors. Extend conduit at least 6 inches above top of floor. If the cable is to be terminated at that location at floor level, do not extend conduit.
    c. No LB conduits shall be allowed.

d. If pull boxes are installed, they must be of the Quazite type. Boxes must be large enough to maintain a minimum bending radius for cables. No molded plastic type boxes may be substituted.
e. Backboxes/outlet boxes shall be mounted at 18 inches above the finished floor to center of outlet unless noted otherwise on the drawings.
f. Installer shall maintain the minimum distance from sources of electromagnetic interference: 6 inches from power circuits; 1 foot from fluorescent and HID lamps; and 4 feet from transformers, meters and variable frequency drives.
g. All raceway elbows shall be long radius elbows.
h. Make sure conduits are properly terminated, reamed, and brushed before installation of cable(s).
i. Install proper support for all 2 ½" or larger conduits and all cable trays.
j. Install seismic flexible fitting on all 2 ½" or larger conduits entering or leaving the building.

3. Network Cabling Installation
    a. All cables shall be terminated using the TIA/EIA-568-B standard.
    b. All horizontal networking cabling that is not in a conduit must be installed with J-hooks. Support cable bundles at 4 feet on center maximum. Do not exceed 50% of hook.
    c. Horizontal networking J-hooks will only be used for Ethernet cabling. No other cabling can be added, such as fire alarm or electrical cabling.
    d. For any device used for cable support, whether J-hook, caddy straps, conduits, or ladders racks, do NOT exceed 50% of support capacity.
    e. Cables shall be continuous, without splicing, from patch panels to outlets.
    f. Do not peel back cable sheath more than necessary to separate conductors.
    g. Do not score copper conductors when peeling back conductor insulation. Scored conductors shall be replaced.
    h. Do not bend cables with a radius less than five times the cable's diameter. Cables bent with a radius less than this shall be replaced.
    i. Kinked, torn, or twisted cable sheaths are unacceptable and will be replaced.
    j. Install cables to avoid water, high humidity, chemicals, cold temperature bending, pair spreading, pair wrapping, and different lengths of pairs in same cable.
    k. Do not bundle more than 216 four-pair cables or 36 twenty-five pair cables.
    l. Do not criss-cross cables or allow them to become interwoven.
    m. Maintain the following clearances for cables:
        i. 6 inches from power circuits.
        ii. 12 inches from light fixtures.
        iii. 12 inches from hot water pipes, steam pipes and flues.

    iv. 48 inches from transformers, meters, VFDs, and power correction systems.

n. Cables of different families shall cross at a 90 degree right angle.
o. All cables exiting a room will be collected/bundled above corridor ceilings and travel along corridors to the MDF & IDF.
p. Cable bundles must be secured via Velcro straps, do not use tie wraps.
q. Install cables in ceilings in a manner to permit service, maintenance, or replacement of adjacent equipment without disrupting the position of the network cables.
r. A service loop shall be retained, in the ceiling, at each individual wall jack with enough excess to relocate current jack location to any wall within room; not to exceed maximum distance length for Category 6 cabling standard.
s. Install outlets at 18 inches above finished floor to center of outlet, unless noted otherwise on the drawings.
t. Install outlets 6 inches above finished countertops to center of outlet.
u. When running lines for wireless or camera deployments, there must be a location to mount the wireless access point or camera.
    i. A single gang box in solid ceilings will be sufficient. These boxes must be installed horizontally as wireless access points and cameras must be installed horizontally. If at all possible, boxes must be flush mounted with the wall.
    ii. If the line is run in an “open” ceiling then the network line must be run in a conduit with a single gang box or double gang box with mud ring terminating the conduit. These boxes must be installed horizontally as wireless access points and cameras must be installed horizontally.
    iii. ASU-ITS will supply mounting bracket for reference on request.
    iv. Wireless and camera line locations above ceiling grid need to have locations marked on the grid with a removable marker such as a small piece of tape.
    v. As wireless and camera installs are exact in their nature and often cannot be moved, network lines MUST be installed at the EXACT location stated on the building diagram unless there is an obstruction. If they have to be moved for ANY reason, ASU-ITS must be notified immediately.
v. Floor penetration requirements:
    i. Floor penetrations should not exceed 4 inch diameter. Must be cleanly drilled and have fireproofing and sealant installed.
    ii. All wiring going through floor penetrations must be in conduit.
w. Wall penetration requirements:
    i. Penetrations 1 inch and larger shall be sleeved.
    ii. Grout sleeves in place using materials similar to wall construction.

iii. Install fireproofing and sealant at all cable penetrations through firewalls.

x. Fireproofing instructions:
    i. Follow all manufacturers' printed instructions.
    ii. Insert insulation around wiring and wiring bundles passing through walls and floors with a minimum depth of 2 inches then cover insulation with a 2 inch thick smoke seal compound.

4. Networking Closet (MDF & IDF) Requirements
    a. Networking closets must have the following MINIMUM dimensions:
        i. 9' of clear space to ceiling.
        ii. Open floor space of 10'x10'.
    b. Networking closets must have independently controlled HVAC facilities.
    c. Networking closets must have independently controlled lighting.
    d. Networking closets must have dedicated power circuits, with a minimum of four outlets.
    e. Networking closets need to be stacked on top of each other between floors if at all possible.
    f. Networking closet space shall be dedicated to telecommunications/networking functions and related support facilities only. Networking closets shall not be shared space with electrical, mechanical, janitorial, security, or any other facilities.
    g. Networking closets shall be free of all plumbing.
    h. Networking closets will only have one entrance and that entrance will be connected to a main corridor or to the exterior of the building.
    i. Networking closets need to have either card access or a bolted lock for access.
    j. A minimum of two walls shall be covered with rigidly fixed ¾ A-C plywood, void free. Extend from 12 inches above the finished floor (AFF) to 84 inches AFF and capable of supporting the attached equipment. Plywood shall be painted to match the closet.
    k. Bolt bottom of networking rack to floor and bolt top of rack to wall.
    l. Cables entering the MDF or IDF location will be placed on J-hooks and then ladder racks. Those devices will carry the network cable to the 19-inch racks where they will be terminated.
    m. Terminate all network cables onto a patch panel. At all patch panel terminations:
        i. Keep pairs twisted up to termination.
        ii. At patch panels, Velcro cable bundles.
        iii. Terminate cabling to patch panels with lengths of cable sufficient to prevent binding on the brackets or angles of the rack.
        iv. Allow 3 to 5 feet of service loop for future adds, moves, and changes at the rack.
        v. Provide a service ground for network rack in accordance to EIA/TIA-607 Standard.

n. Networking equipment will NOT be installed until construction of the closet is complete, secured, and clean. All above requirements must be met, including HVAC, before networking equipment will be installed. This is due to the equipment being a campus security risk if left unsecured and the equipment being highly susceptible to environmental conditions. If ASU-ITS is forced to install equipment for any reason before the above requirements are met, then ASU-ITS will not guarantee continued functionality of the equipment or the network and are not responsible for theft or damage to said equipment.

5. Network Cable Testing
    a. All network cabling and fiber-optic cabling must be tested and must pass the following criteria.
    b. Testers shall use permanent link equipment.
    c. All cabling not tested strictly in accordance with the following procedures shall be retested at no additional cost to ASU-ITS.
    d. All network cabling must pass CAT-6 standards at the minimum.
    e. All cables must pass fully. No “Pass*” will be allowed.
    f. All fiber-optic cables must pass with a maximum of 0.75 dB of loss.
    g. Test results must be submitted to ASU ITS Telecom before any work can be signed off on.
6. Network Cable Identification
    a. Every network cable installed will be labeled at the jack and on the patch panel. No label will be handwritten. Lettering on label will be at least ¼ inch tall. Labels located on faceplates will be black letters on a white tape, unless otherwise stated by ASU-ITS.
    b. Network cables will be labeled at the jack using the following system: MDF/IDF Floor. MDF/IDF Number. Patch Panel Letter. Patch Panel Port Number. Room number. For example, a port in room 342 that goes to IDF1 on the third floor on patch panel B port 25 would be: 3.1.B.25.342. Use “M” when designating the MDF.
    c. Network cables will be labeled on the patch panel on the rack according to the room number at which they terminate.
    d. Proper labeling is a mandatory part of the project and the project will not be considered finished until the labeling is completed.
7. Intra-building Fiber-Optic Cable Installation
    a. There will be 12 single mode fibers connecting each IDF of a building to the MDF of the same building. All IDF fiber-optic installations will be homeruns from the IDFs to the MDF with no splicing allowed.
    b. Fiber boxes installed in the MDF closet shall be installed at least two rack units away from the top of the rack with no additional equipment installed above or closer than four rack units below. Please verify with ASU-ITS on MDF fiber box placement as each MDF has different requirements.
    c. Fiber boxes installed in the IDF closet shall be installed at the top of the

rack with no additional equipment installed above or closer than four rack units below.

d. Each fiber-optic cable shall be installed in its own connector panel or panels. For example, two 4 strand cables would be placed on two separate connector panels even if there were 8 possible connections on one panel.
e. The contractor will ensure that every optical fiber is installed in such a manner that it does not rest on or is tied to any existing ductwork, conduits, or any other objects located in the ceiling. The optical fiber cable will at no time rest on any ceiling tile.
f. The contractor will be aware of all minimum bend radiuses for all cables.
g. Optical fiber cables will not rest in the same J-hooks as network cables.
h. If the number of optical fiber cables traveling through one area exceeds three (3), the contractor will install a separate set of J-hooks for the optical fiber cable.
i. Fiber housings and termination materials must be of the Corning brand. Contractors must consult with ASU ITS Telecom for the type of connector to be used when terminating fibers.

8. Inter-Building Fiber-Optic Cable
    a. There will be a minimum 12 Single Mode fibers connecting each building MDF when necessary unless specified by customer or project. Each connection will be a homerun; splicing will not be accepted.
    b. A minimum of two 4" conduits between buildings will be installed. Fiber optic and copper cable may be placed in same conduit, leaving one 4" conduit as a spare for future expansion. Pull strings will be left in conduit. Woven polyester mule tape Neptco p/n WP2500P-3000 or equivalent shall be used. (Anixter p/n 486356).
9. Emergency Stanchion Installation
    a. Conduits to the stanchion must originate from the closest networking closet of the building that handles the infrastructure of the stanchion.
    b. One 1-½" conduit will be installed to the stanchion. Pull strings will be left in conduit. Woven polyester mule tape Neptco p/n WP2500P-3000 or equivalent shall be used. (Anixter p/n 486356).
    c. Power must be placed in a separate conduit.
    d. Fiber-optic cabling should be single mode fiber with ST connectors (see SECTION 2 parts 12 &13).
    e. Stanchions must be installed according to the instructions found in SECTION 5 – Addendum.
10. ASU-ITS must approve any requested changes to procedures in writing. Current valid representatives of ASU-ITS are Tony Marshall, Scott Wheat, Eric Barnett, or Chris Doyle.
11. Final payment will not be made unless all procedures have been followed and recommended equipment has been utilized.

SECTION 4 – Deliverables

1. Cable Testing
    a. Contractor will provide a detailed report for all Ethernet and fiber-optic tests. Report will have, at a minimum, pass/fail results for each line run including room number and patch panel number.

SECTION 5 – Addendum

1. Valcom stanchion installation instructions.

VALCOM

Issue 1

VIP-9811 ANCHOR BOLT FOUNDATION INSTALLATION

INTRODUCTION

Anchor bolts must be installed in a solid foundation to support the VIP-9811 tower. The included instructions provide information on installation of the anchor bolts in a customer-provided foundation. *It is the installer's responsibility to determine and follow any applicable building codes and restrictions for their site.*

Note: These instructions are for anchor bolt installation only. For instructions on installing the tower onto the anchor bolts, see the Tower installation instructions.

CONTENTS

Before beginning installation, make sure you have all the included components.

Qty.	Description
4	J-Bolts
1	Metal Template
4	¾" Washers
4	¾"-10 Hex Nuts

INSTALLATION

Provide a 4 inch diameter conduit area for any electrical, telephone, network or other signal connection required. Conduit(s) should be installed into the center of the foundation to align with the 4 inch diameter hole in the base of the tower.

NOTE: To insure proper grounding of all electrical components, the tower must be effectively earth grounded.

Use minimum 6 AWG or better, stranded, insulated copper wire to connect the tower ground lug located on the inside bottom base plate to an earth ground. Use a minimum 8 foot length, 0.5 inch (1/2") diameter, corrosion-resistant ground rod installed directly under the tower.

NOTE: Make sure all connections meet National, Regional, and Local Electric Codes.

Pour the foundation at least 2 feet in diameter or 2 feet square and 3 feet deep accordingly to your local code and frost line (see foundation drawing, Figure 1).

Install the four (4) 3/4" – 10 x 24 anchor bolts into the foundation **with 4 and 1/2 inches (4 1/2") projecting above the top of the foundation** (see foundation drawing, Figure 1).

Use the template provided to properly position the J-bolts within the concrete foundation.

TECHNICAL ASSISTANCE

Assistance is available from the factory when problems are encountered. Call (540) 563-2000 and press 1 for Technical Support or visit our website at http://www.valcom.com

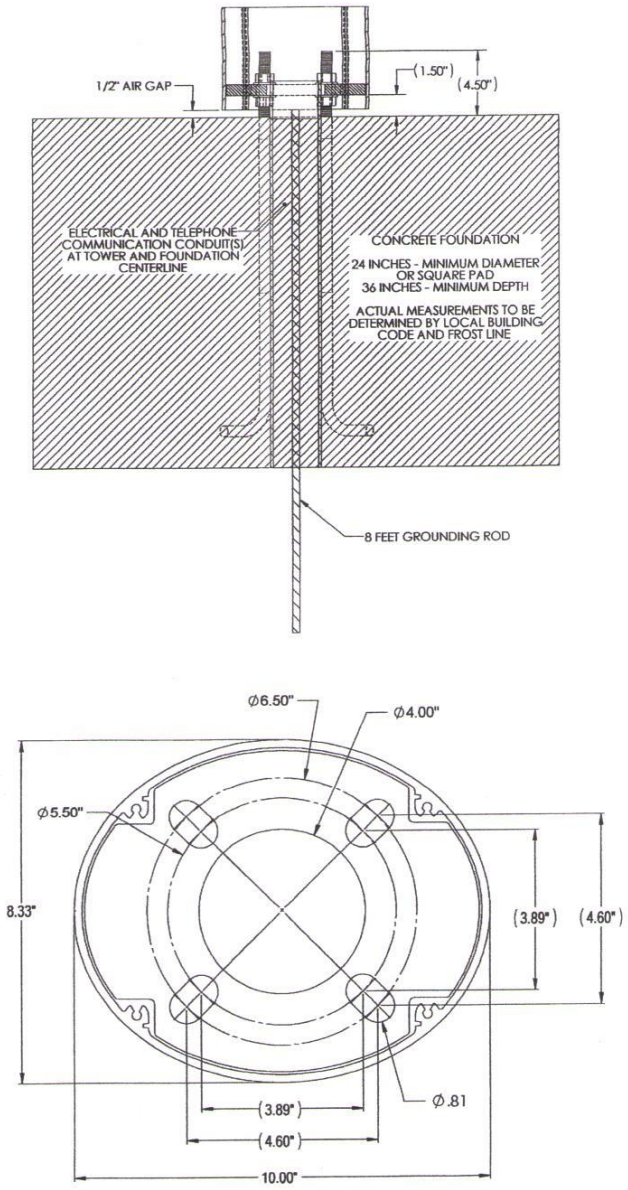


Figure 1. Installation must comply with all national, state, and local construction and electrical codes.

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Selective demolition and removal of selected site elements.
2. Abandonment and removal of existing utilities and utility structures.

B. Related Requirements:

1. Section 312000 "Earth Moving"

C. References

1. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
2. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2004.

1.2 SUBMITTALS

A. Site Plan: Showing areas for temporary construction and field offices.

B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
2. Identify demolition firm and submit qualifications.
3. Include a summary of safety procedures.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.3 QUALITY ASSURANCE

A. Demolition Firm: Company specializing in the type of work required.

1.4 PROJECT CONDITIONS

A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 SCOPE

A. Remove paving and curbs as required to accomplish new work.

B. Remove other items indicated, for salvage, relocation, and recycling.

C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.
2. Comply with applicable requirements of NFPA 241.
3. Use of explosives is not permitted.
4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
5. Provide, erect, and maintain temporary barriers and security devices.
6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
7. Do not close or obstruct roadways or sidewalks without permit.
8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from the Owner.

C. Protect existing structures and other elements that are not to be removed.

1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

D. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

E. Perform demolition in a manner that maximizes salvage and recycling of materials.

1. Dismantle existing construction and separate materials.
2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.3 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to the owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to the owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

I. Coordinate re-location or modifications to all utilities affected by new access street tie ends to any public or private drives and or streets.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as shown.
2. Report discrepancies to landscape architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

C. Remove existing work as indicated and as required to accomplish new work.

1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.

1. Maintain existing active systems that are to remain in operation; maintain access

to equipment and operational components

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment; remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.5 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.
B. Welded-wire reinforcement.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.
B. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.
C. 04 72 00 Cast Stone Masonry: Reinforcement for masonry.

1.3 REFERENCE STANDARDS

A. ACI MNL-66 - ACI Detailing Manual; 2020.
B. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2026.
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
E. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.
F. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
G. CRSI (DA4) - Manual of Standard Practice; 2024.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Shop Drawings: Comply with requirements of ACI MNL-66 Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
    1. Location of construction joints is subject to approval by Architect.
D. Control Joint Layout: Indicated proposed control joints required to build the structure in slabs and walls.
    1. Location of control joints is subject to approval by Architect.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed.
B. Headed-Steel Reinforcing Steel: ASTM A970/A970M.
C. Deformed Bar Anchors: ASTM A1064/A1064M, Type C.
D. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
    1. Form: Flat Sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut 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.

1. Fabricate concrete reinforcing in accordance with CRSI (DA4)- Manual of Standard Practice, of greater compressive strength than concrete as follows:
2. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 in diameter.
1. Finish: Plain.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
B. Welding of reinforcement is not permitted.
C. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.
1. Galvanized Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI (DA4).
D. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
E. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
B. Do not displace or damage vapor barrier.
1. Repair damage and reseal vapor retarder before placing concrete.
C. Accommodate placement of formed openings.
D. Maintain concrete cover around reinforcing as follows:
1. Supported Slabs and Joists: 2 inch.
2. Column Ties: 1 1/2 inch.
3. Walls (exposed to weather or backfill): 2 inch.
4. Footings and Concrete Formed Against Earth: 3 inch.
5. Slabs on Fill: 3 inch.
E. Comply with applicable code for concrete cover over reinforcement.
F. Bond and ground all reinforcement to requirements of Section 26 05 26.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
B. Accurately position, support, and secure reinforcement against displacement.
1. **Locate and support reinforcement with bar supports to maintain minimum concrete cover.** Do not position horizontal slab reinforcing by pulling on reinforcement during concrete placement.
2. Do not tack weld crossing reinforcing bars.
C. Preserve clearance between bars of not less than **1 inch**, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
D. Provide concrete coverage in accordance with ACI CODE-318.
E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
F. Splices: Lap splices as indicated on Drawings.
1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI CODE-318.
3. Weld reinforcing bars in accordance with AWS D1.4/D1.4M, where indicated on Drawings.
G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI's "Manual of Standard Practice".
a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed **12 inches.**

2. Lap edges and ends of adjoining sheets at least one wire spacing plus **9 inches** for plain wire and **9 inches** for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. 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.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. 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.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 40 00 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION 03 20 00

This page intentionally left blank

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete formwork.
B. Concrete for composite floor construction.
C. Floors and slabs on grade.
D. Concrete foundation walls.
E. Joint devices associated with concrete work.
F. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
G. Concrete curing.
H. Concrete floor treatment.
I. Site retaining walls.
J. Sheet vapor barrier under concrete slab on grade.
K. Water stops.
L. **Board Insulation at the underside of concrete slabs and below-grade at the perimeter of the foundation and slab Edges.**

1.2 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing.
B. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
C. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

1.3 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code for Structural Concrete—Code Requirements and Commentary; 2025.
B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
E. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
F. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
G. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
H. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
I. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.
K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.
L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2026.
M. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
N. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.
O. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2025.
P. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.
Q. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2025a.
R. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
S. ASTM E1155/E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2023.
T. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2024.

U. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
V. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
    1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
    2. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions.
    3. Insulation product characteristics, performance criteria, and product limitations.
C. Mix Design: Submit proposed concrete mix design.
    1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
    2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
    3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
D. Shop Drawings:
    1. Concrete Formwork: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
    2. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
        a. Location of construction joints is subject to approval of the Architect.
E. Test Reports: Submit report for each test or series of tests specified.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
B. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.1 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
    1. Design and construct concrete that complies with the design with respect to shape, lines, and dimensions.
B. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in the largest practicable sizes to minimize number of joints.
    1. Form Facing for Exposed Finish Concrete: Provide continuous, true, smooth, and stain-free final appearance.
        a. Plywood, metal, or other approved panel materials.
        b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
            1) High-density overlay, Class 1 or better.
            2) Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
            3) Structural 1, B-B or better; mill oiled and edge sealed.
            4) B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
        c. Overlaid Finnish birch plywood.
        d. Furnish in largest practicable sizes to minimize number of joints.
C. Form Facing for Encapsulated Finish Concrete: Plywood, lumber, metal, form liners or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
    1. Where not exposed to view.

D. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

E. 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.

F. Chamfer Strips: Rigid plastic, or elastomeric rubber, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.

G. Rustication Strips: Rigid plastic, or with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch (6 mm) thick.

I. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.

J. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

K. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
2. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.2 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 20 00.

2.3 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cement: ASTM C150/C150M, Type II - Moderate Portland type.

C. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire aggregates for entire project from same source.
2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Fly Ash: ASTM C618, Class C or F.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.4 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

G. Retarding Admixture: ASTM C494/C494M Type B.

H. Water Reducing Admixture: ASTM C494/C494M Type A.

2.5 ACCESSORY MATERIALS

A. **Underslab Vapor Retarder:**

1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
    a. Not less than 15 mils thick.
2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Carlisle Coatings & Waterproofing, Inc.
    b. Stego Industries, LLC.
    c. Tex-Trude.
    d. W. R. Meadows, Inc.

B. Granular Fill: Clean mixture of crushed stone or crushed or un-crushed gravel; ASTM D448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Expansion-and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

D. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

E. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

F. Floor Slab Protective Covering: 8-feet- wide cellulose fabric.

2.6 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation (At perimeter horizontal insulation locations under slab and at perimeter vertical insulation locations at slab edge and foundations): Comply with ASTM C578.
1. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type VI, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
    a. Thickness: 2 inches, to achieve a min. R-value of 10, unless otherwise noted.
5. Wall Insulation Drainage Panels: Fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.
    a. Thermal resistances: 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F per inch of thickness
    b. Locations: Below-grade vertical insulation with earth against the insulation.
    c. Thickness: 2 inches, to achieve a min. R-value of 10, unless otherwise noted.
6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Chemical Company (The).
    b. Ownern Corning.
    c. Johns Manville.
    d. ROCKWOOL
    e. Thermafiber, Inc.
7. Adhesive: Type recommended by the insulation manufacturer for application.
    a. Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.7 BONDING AND JOINTING PRODUCTS

A. Waterstops: PVC, complying with COE CRD-C 572, with factory installed metal eyelets for embedding in concrete to prevent passage of fluids through joints. **Factory fabricate corners, intersections, and directional changes.**
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BoMetals, Inc.
b. Greenstreak.
c. Paul Murphy Plastics Company.
d. Vinylex Corp.

2. Configuration: Ribbed with center bulb.
3. Size: 6 inches by 3/8 inch thick; non-tapered, unless noted otherwise on drawings.
4. Location: As indicated on the drawings.

B. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.

1. Products: Subject to compliance with requirements, provide one of the following products or a comparable product of other manufacturers.
a. Nomaco, Inc; Fastflex Slab Isolation Joint Filler with Tear-Off Strip: www.nomaco.com/#sle.
b. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com/#sle.
c. W. R. Meadows, Inc; Ceramar Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.

C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

2.8 LIQUID FLOOR TREATMENT

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatments Finish at sealed concrete floors: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for sealed concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following products or a comparable product of other manufacturers.
a. Advanced Floor Products; Retro-Plate 99.
b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.9 CURING MATERIALS

A. Evaporation Reducer: Waterborne, liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Dayton Superior Corporations.
b. Euclid Chemical Company (The); an RPM company.
c. W.R. Meadows, Inc.
d. Master Builder Solutions; a BASF company

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

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

D. Curing and Densifying Compound, Membrane-Forming: Lithium polysilicate-based, clear, liquid densifier for application to newly-placed concrete.

1. Comply with ASTM C309.
2. VOC Content: Less than 50 g/L.
3. Solids Content: 25 percent, minimum.

E. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.

1. Vehicle: Water-based.
2. Solids by Mass: 25 percent, minimum.
3. VOC Content: OTC compliant.

F. Water: Potable, not detrimental to concrete.

2.10 CONCRETE MIX DESIGN

A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

B. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

C. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
   2. Fly Ash Content: As indicated on drawings.
   3. Water-Cement Ratio: As indicated on drawings.
   4. Maximum Aggregate Size: 5/8 inch.

2.11 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M, and furnish batch ticket information.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

2.12 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 C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   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 4000 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   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 in accordance with ASTM C109/C109M.

C. **Do not parge coat concrete exposed to view.**

2.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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:
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.
B. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
   1. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI SPEC-117.
   2. Chamfer exterior corners and edges of permanently exposed concrete as indicated on Drawings.
B. Verify that forms are clean and free of rust before applying release agent.
C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
D. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.
   3. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
   4. Protect vapor retarder during placement of reinforcement and concrete.
      a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
E. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.
B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
D. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.4 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install boards in an orientation as recommended by manufacturer on foundation perimeter.

1. Butt edges and ends tightly to adjacent boards and to protrusions.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

D. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

E. BOARD INSTALLATION UNDER CONCRETE SLABS

1. Place insulation under slabs on grade after base for slab has been compacted.
2. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
3. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 FINISHING FORMED SURFACES

A. Board Formed Finish: Apply the following to board formed concrete where indicated:

B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Remove forms after concrete is set but not appreciably hardened. 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 coat surfaces or apply any grout to the face of concrete. Comply with ACI 301-96 for Rubbed Finish.

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

3.6 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. 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.

C. Apply float finish to surfaces indicated.

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.
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 1/8 inch

E. Broom Finish: Apply broom finish to exterior concrete walks, pads 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

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate, finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
   1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
   2. After broadcasting and tamping, apply float finish.
   3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.7 FORM REMOVAL AND CLEANING

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

D. Clean forms as erection proceeds, to remove foreign matter within forms.
   1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.8 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
   1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.
   1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
   2. Place joints perpendicular to main reinforcement.
      a. Continue reinforcement across construction joints unless otherwise indicated.
      b. Do not continue reinforcement through sides of strip placements of floors and slabs.
   3. Space vertical joints in walls at two times wall height unless otherwise indicated on Drawings. Locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
   4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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

3.9 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 40 00, will inspect finished slabs for compliance with specified tolerances.
B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155/E1155M, within 48 hours after slab installation; report both composite overall values and local values for each measured section.
D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.10 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.
B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
D. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI PRC-302.1; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
3. Decorative Exposed Surfaces: Trowel as described in ACI PRC-302.1; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
4. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.
E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.11 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.12 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.
B. Camber slabs and beams in accordance with ACI SPEC-301.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to testing firm for review prior to commencement of concrete operations.
D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure four concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
G. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.14 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.15 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.
B. Protect concrete floor surface after grinding and polishing until final cleaning.

END OF SECTION 03 30 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete masonry units (CMUs).
B. Brick Veneer
C. Mortar and grout.
D. Reinforcement and anchorage.
E. Flashings.
F. Lintels.
G. Accessories.
H. Through-wall flashing for stone masonry is included in this section, but shall also comply with the requirements of Division 7 section: “Sheet Metal Flashing and Trim”
I. Products Installed but not Furnished under This Section:
    1. Steel lintels in unit masonry.
    2. Cavity wall insulation.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
B. Section 04 72 00 - Cast Stone Masonry: For cast stone copings at top of architectural concrete block walls.
C. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
D. Section 07 21 00 - Thermal Insulation: **Insulation for cavity spaces.**
E. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
F. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2026.
C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).
D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2026.
E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
F. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2025.
G. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.
H. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.
I. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2026.
J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2025.
K. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.
M. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2024.
N. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025b.
O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
P. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
Q. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2025a.
R. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2024.
S. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
T. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2024.

U. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
V. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls; 2025.
W. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
X. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
Y. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, and integral water repellent.
C. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and location of special shapes
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
D. Samples: Submit four samples of brick veneer units to illustrate color, texture, and extremes of color range.
E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
G. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.6 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

1.7 MOCK-UPS

A. See Section 01 40 00-Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.
C. Construct a sample panel of each type of exposed masonry wall, panel sized 4 feet long by 4 feet high.
   1. Build sample panel facing south.
   2. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
D. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Architect specifically accepts such deviations in writing.

1.8 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

2.1 CONCRETE MASONRY UNITS

A. Integrally Colored Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, and other detailed conditions.
      a. Provide square-edged units for outside corners.
   3. Unit Compressive Strength: See Drawings.
   4. Load-Bearing Units: ASTM C90, Lightweight at locations above grade and not exposed to weather, and normal weight at locations exposed to weather and below grade..
      a. Hollow block, as indicated.
      b. Exposed Faces: Manufacturer's standard color and texture.
      c. Color and Texture: As selected by the Architect from the full range of colors, the intent is to match the color range of the brick veneer; Smooth.
   5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at time of manufacture.
      a. Performance of Units with Integral Water Repellent:
         1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            (a) No water visible on back of wall above flashing at the end of 24 hours.
            (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
         2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
         3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
      b. Use only in combination with mortar that also has integral water repellent admixture.
      c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

2.2 BRICK UNITS

A. **Basis of Design**: Provide Mission Blend (ASU Blend) as manufactured by Acme Brick or a comparable product of other manufacturers approved by the Architect.
B. Pattern: As indicted on drawings.
C. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
   1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
   2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
      a. Lipped brick typical at lintels.
   3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
   4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
D. Facing Brick: ASTM C216, Type FBS, Grade SW.
   1. Blend/Color: 3 color Blend (33% each) Mission 1, Mission 2, Mission 3
   2. Texture: Velour
   3. Actual size: Modular (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long..
   4. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

5. Compressive strength: Provide units with minimum average net-area compressive strength of 3000 psi., measured in accordance with ASTM C67/C67M.
6. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
7. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "no efflorescence."
8. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet away, and shall have a history of successful use in Project's area.

2.3 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type S.
   1. Colored Mortar: Premixed cement as required to match Architect's color sample.
B. Portland Cement: ASTM C150/C150M, Type I.
   1. Not more than 0.60 percent alkali.
C. Hydrated Lime: ASTM C207, Type S.
D. Mortar Aggregate: ASTM C144.
E. Grout Aggregate: ASTM C404.
F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As selected by Architect from manufacturer's full range.
      a. Color for Brick: Colors to be selected from manufacturer’s full range of standard and premium colors, with the intent to match the existing buildings mortar color on campus.
      b. Color for CMU: Colors to be selected from manufacturer’s full range of standard and premium colors.
   2. Products: Subject to compliance with requirements, provide one of the following products or a comparable product of other manufacturers.
      a. Solomon Colors, Inc.; SGS Mortar Colors.
      b. Davis Colors; True Tone Mortar Colors.
      c. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
G. Water: Clean and potable.
H. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Use only in combination with masonry units manufactured with integral water repellent admixture.
   2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
   3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.4 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss.
   2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
   3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
D. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss, with adjustable ties spaced at 16 in on center.
   2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
   3. Size: 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.

4. Seismic Feature: Include clip on extended leg of wall ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter. Course spacing per structural.

E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
   1. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
   2. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
   3. Vertical adjustment: Not less than 3-1/2 inches.
   4. Seismic Feature: Provide clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter. Course spacing per structural.

2.5 EMBEDDED FLASHING MATERIALS

A. **Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:**
   1. Provide as indicated in drawings.
   2. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
   3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
   4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
   5. Fabricate through-wall flashing with **hem flush with face of veneer**. **No exposed drip edges in field of veneer** unless otherwise indicated. Fabricate by extending flashing to FACE of wall, with outer edge hemmed. Hemmed-edge flashing must be sealed and adhered to surface below to prevent water from entering under flashing. See International Masonry Institute for typical reference detail with no exposed drip edge.
   6. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
   7. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
   8. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: **Use the following unless otherwise indicated**:
   1. Self-adhering flexible flashing: composite impermeable membrane consisting of butyl and HDPP facer that has a pressure-sensitive, clear adhesive that will not drool when exposed to UV or heat.
      a. EXOAIR 110AT by TREMCO, Inc. or equal.
   2. Properties:
      a. Self-Adhesive Sheet: 22 mil. thick.
      b. Tensile Strength: 28lbf/in per ASTM D 882.
      c. Ultimate Elongation: 25 percent.
      d. Shore A Hardness: 83 per ASTM D 2240.
   3. Accessories: Provide primer, sealant, stainless steel termination bars, preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
      a. Sealant: Dymonic 100.
   4. Apply to clean, dry surfaces.

5. Extend flashing beyond the wall face and cut flush with the outside face of veneer. A drip edge is not required.
6. Install per manufacturer’s recommendations. Verify compatibility with insulation materials and weather barriers prior to installation.
7. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.

C. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge .
4. Where flashing is fully concealed, use flexible flashing.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

2.6 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding; in maximum lengths available.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1) Advanced Building Products Inc; Mortar Break: www.advancedbuildingproducts.com/#sle.
2) Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
3) Substitutions: See Section 01 60 00 - Product Requirements.

D. Weeps:
1. Type: Molded PVC grilles, insect resistant.
2. Color(s): As selected by Architect from manufacturer's full range.

E. Cavity Vents:
1. Type: Molded PVC grilles, insect resistant.
2. Color(s): As selected by Architect from manufacturer's full range.

F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.7 LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with fine grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

B. Steel Lintels: As indicated on the drawings.

2.8 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type M.
2. Exterior, loadbearing masonry: Type S.
3. Exterior, non-loadbearing masonry: Type S.
4. Interior, loadbearing masonry: Type S.
5. Interior, non-loadbearing masonry: Type S.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 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. Concrete Masonry Units:
    1. Bond: Running.
    2. Coursing: One unit and one mortar joint to equal 8 inches.
    3. Mortar Joints: Concave.
D. Brick Units:
    1. Bond: Running.
    2. Coursing: Three units and three mortar joints to equal 8 inches.
    3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar and mortar smears as work progresses.
E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
F. Interlock intersections and external corners.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen dampproofing is applied.
J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

3.7 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.8 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches 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 mortar cover on each side.
E. Lap joint reinforcement ends minimum 6 inches.
F. Reinforce joint corners and intersections with strap anchors 16 inches 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 horizontally and 24 inches vertically.

3.9 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
C. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
    1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 2 inches, minimum, to form watertight pan at nonmasonry construction.
    2. Remove or cover protrusions or sharp edges that could puncture flashings.
    3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Terminate flashing up 8 inches minimum on vertical surface of backing:
    1. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer’s directions.
    2. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
D. Extend metal flashings through exterior face of masonry and terminate in a flat drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing. No exposed drip edge ot metal flashing shall extend over the face of the masonry unless shown otherwise in the drawings.
E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.11 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.
C. Maintain minimum 8 inch bearing on each side of opening.

3.12 GROUTED COMPONENTS

A. Lap splices minimum 48 bar diameters.
B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
C. Place and consolidate grout fill without displacing reinforcing.

3.13 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
D. Form expansion joint as detailed on drawings.

3.14 BUILT-IN WORK

A. As work progresses, install built-in metal door frames, glazed frames, and plates and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
    1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.15 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.
B. Maximum Variation from Alignment of Columns: 1/4 inch.
C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.16 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.

3.17 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.18 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.

3.19 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

B. Cover Architectural Concrete Block walls each day after installation. Take special care to protect from moisture penetration. After units are installed they should be protected from damage by other trades. Walls should be covered with plastic or plywood to prevent staining or chipping.

END OF SECTION 04 20 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural cast stone.
B. Units required are indicated on drawings as "cast stone".

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Installation of cast stone in conjunction with masonry.
B. Section 04 20 00 “Unit Masonry” for through-wall flashing and miscellaneous masonry accessories.
C. Section 07 21 00 - **Insulation: for cavity wall insulation.**
D. Section 07 92 00 - Joint Sealants: Sealing joints indicated to be left open for sealant.
E. Section 07 62 00 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code for Structural Concrete—Code Requirements and Commentary; 2025.
B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2026.
C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2024.
D. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.
E. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2025.
F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.
H. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025b.
J. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.
K. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete; 2021.
L. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2024.
M. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2025.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Product Data: Test results of cast stone components made previously by the manufacturer.
C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
D. Mortar Color Selection Samples.
E. Samples: Pieces of actual cast stone components not less than 6 inches square, illustrating range of color and texture.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Current producer member of the Cast Stone Institute or the Architectural Precast Association.
   2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

B. Number each piece individually to match shop drawings and schedule.
C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
F. Store mortar materials where contamination can be avoided.
G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Midwest Cast Stone or similar product by:
   1. Any current producer member of the Cast Stone Institute.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural sandstone, complying with ASTM C1364.
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
   4. Color: Selected by Architect from manufacturer's full range.
   5. Remove cement film from exposed surfaces before packaging for shipment.
B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.
C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.3 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Mortar: Type I or II, except Type III may be used in cold weather.
B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.
E. Admixtures: ASTM C494/C494M.
F. Water: Potable.
G. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi), deformed bars, galvanized.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.
   2. Epoxy coated in accordance with ASTM A775/A775M.
H. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
I. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
J. Mortar: Portland cement-lime, as specified in Section 04 05 11 ; do not use masonry cement.

K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.4 SOURCE QUALITY CONTROL

A. Test compressive strength and absorption of specimens selected at random from plant production.
   1. Test in accordance with ASTM C642.
   2. Select specimens at rate of 3 per 500 cubic feet, with a minimum of 3 per production week.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00 and Section 04 43 13.
C. Mechanically anchor cast stone units indicated; set remainder in mortar.
D. Setting:
   1. Drench cast stone components with clear, running water immediately before installation.
   2. Set units in a full bed of mortar unless otherwise indicated.
   3. Fill vertical joints with mortar.
   4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch, except as otherwise detailed.
   1. Rake mortar joints 3/4 inch for pointing.
   2. Remove excess mortar from face of stone before pointing joints.
   3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.
   4. Leave the following joints open for sealant:
      a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
      b. Joints in projecting units.
      c. Joints between rigidly anchored units, including soffits, panels, and column covers.
      d. Joints below lugged sills and stair treads.
      e. Joints below ledge and relieving angles.
      f. Joints labeled "expansion joint".
B. Installation Tolerances:
   1. Variation from Plumb: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet or more.
   2. Variation from Level: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet, or 3/8 inch maximum.
   3. Variation in Joint Width: Not more than 1/8 inch in 36 inches or 1/4 of nominal joint width, whichever is less.
   4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.
B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
C. Repair methods and results subject to Architect 's approval.

3.5 CLEANING

A. Keep cast stone components clean as work progresses.
B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
    1. Wet surfaces with water before applying cleaner.
    2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
    3. Remove cleaner promptly by rinsing thoroughly with clear water.
    4. Do not use acidic cleaners.

3.6 PROTECTION

A. Protect completed work from damage.
B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION 04 72 00

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural steel framing members.
B. Structural steel support members.
C. Base plates, shear stud connectors and expansion joint plates.
D. Grouting under base plates.

1.2 RELATED REQUIREMENTS

A. Section 05 21 00 - Steel Joist Framing.
B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.
D. Section 09 90 00 - Paints, High Performance Paints, Stains, and Coatings: for painting requirements.
E. **Not all steel is shown on the structural sheets. See Architectural drawings for additional steel that is to be used as trim and signage. All steel, even steel that is shown on the architectural drawings, shall be provided by the structural steel subcontractor.**

1.3 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2023, with Errata (2025).
B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022, with Errata (2025).
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2024.
F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
G. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2024.
H. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance; 2024.
I. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
J. 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; 2025.
K. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2023.
L. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2022.
M. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2024.
N. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
O. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
P. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2024.
Q. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a (Reapproved 2023).
R. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
S. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025a.
T. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
U. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Errata (2026).

W. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
X. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
Y. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Shear stud connectors.
   4. Anchor rods.
   5. Threaded rods.
   6. Forged-steel hardware.
   7. Shop primer.
   8. Galvanized-steel primer.
   9. Etching cleaner.
   10. Galvanized repair paint.
   11. Shrinkage-resistant grout.
C. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment Drawings.
   4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
   6. Indicate locations and dimensions of protected zones.
   7. Identify demand-critical welds.
   8. Identify members not to be shop primed.
   9. Connections.
   10. Indicate cambers and loads.
   11. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
D. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
F. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
G. Materials Test Reports: Submit independent test results or engineered performance analysis of structural thermal-break pad performance in bearing or slip-critical connections where shear and moment loads are applied.
H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
I. Fabricator's Qualification Statement.
J. Erector's Qualification Statement.
K. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
L. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

D. Erector Qualifications: A qualified Erector who participates in the AISC Quality Certification Program and is designated an AISC (MAN)-Certified Erector, Category ACSE.

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 corrosion and deterioration.

1. 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.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC (HSBOLT)'s "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 1: Connection designs have been completed, and connections are indicated on the Drawings.
2. Moment Connections: Type FR, fully restrained.
3. Construction: Combined system of moment frame and braced frame.

2.2 MATERIALS

A. Steel Angles, Plates, Channels, and M Shapes: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M.

C. Rolled Steel Structural Shapes: ASTM A992/A992M.

D. Steel Plates and Bars: ASTM A588/A588M high-strength, corrosion-resistant structural steel.

E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.

F. Pipe: ASTM A53/A53M, Type E or Type S,Grade B, Finish black and galvanized, as indicated.

G. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

H. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

I. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

J. Headed Anchor Rods: ASTM F1554 Grade 36, plain.

K. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.

L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

M. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.

2. Minimum Compressive Strength at 28 Days: 6,000 pounds per square inch.
3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
    a. Maximum: Plus 4 percent.
    b. Minimum: Plus 1 percent.

N. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

O. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.3 BOLTS AND CONNECTIONS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
    1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
    1. Finish: Hot-dip zinc coating.
    2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
    1. Finish: Plain.

D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.5 PRIMER

A. Steel Primer:
    1. SSPC-Paint 23, latex primer.
    2. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26.
    1. Etching Cleaner: MPI#25, for galvanized steel.
    2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

C. Zinc-Rich Primer, Tnemec Series 90-97 Tneme-Zinc
    1. Aromatic Urethane, zinc-rich
    2. Zinc Load: 83% by weight in dried film
    3. SSPC Paint 20, Type II
    4. ASTM D 520 Type III

D. SHRINKAGE-RESISTANT GROUT
    1. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
B. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
   1. Mark and match-mark materials for field assembly.
   2. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
C. Shop fabricate to greatest extent possible.
D. 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/D1.1M.
E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
F. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
G. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
H. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
J. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
K. Fabricate connections for bolt, nut, and washer connectors.
L. Develop required camber for members.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.
B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with AASTM A123/A123M.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
B. Galvanize lintels attached to structural-steel frame and located in exterior walls.
   1. Galvanize columns, beams, connections, and miscellaneous steel exposed to exterior.

2.9 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 of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. Standard Shop Primer: SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Zinc-Rich Shop Primer: SSPC-SP 6 Commercial Blast Cleaning with a minimum angular profile of 1.5 mils.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils for standard shop primer and 2.5-3.5 mils DFT for Tnemec Series 90-97 Tneme-Zinc. 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 surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 1.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

B. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

C. 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 on Drawings.
1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

C. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.

D. Weld plate washers to top of baseplate.
1. 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 plate before packing with grout.

2. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

F. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

1. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

G. Splice members only where indicated.

H. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

I. Field weld components indicated on shop drawings.

J. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

K. Do not field cut or alter structural members without approval of Architect.

L. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

N. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

O. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

C. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

D. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIRS

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
2. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Priming: Cleaning and touchup priming are specified in Paintion Section.

3.6 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.7 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

C. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts," testing at least 10 percent of bolts at each connection.

D. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:

1. Radiographic testing performed in accordance with ASTM E94/E94M.
2. Ultrasonic testing performed in accordance with ASTM E164.
3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
4. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION 05 12 00

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
C. Supplementary framing for floor and roof openings greater than 10 inches.

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
B. Section 05 12 00 - Structural Steel Framing: Superstructure framing.
C. Section 05 31 00 - Steel Decking: Bearing plates and angles.
D. Section 05 31 00 - Steel Decking: Support framing for openings less than 10 inches. in decking.
E. Section 05 50 00 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2024.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
D. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2024.
E. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2022.
F. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2024.
G. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
H. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2024.
I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025a.
J. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Errata (2026).
L. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
M. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
N. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders; 2020.
O. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2025.
P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
R. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
D. Designer's Qualification Statement.
E. Manufacturer's Qualification Statement.
F. Fabricator's Qualification Statement.
G. Erector's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.

1. Maintain one copy of document on site.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

E. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

A. Steel Joists:

1. Canam Group Inc: www.canam-steeljoists.ws
2. New Millennium Building Systems: www.newmill.com/#sle.
3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Open Web Joists: Types as indicated on drawings:

1. Provide bottom and top chord extensions as indicated.
2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
4. Finish: Shop primed.

B. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

C. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

D. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Frame special sized openings in joist web framing as detailed.

2.4 PRIMERS

A. Primers:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Primer: Provide shop primer that complies with Section 09 90 00 "Paint, Stains, & Coatings."

2.5 FINISH

A. Shop prime joists as indicated on drawings.
   1. Do not prime surfaces that will be fireproofed.
   2. Galvanize steel ledge angles or as indicated on the drawings.
   3. Leave other steel members unprimed as indicated on the drawings.
B. Prepare surfaces to be finished in accordance with SSPC-SP 2.
C. Galvanizing: Provide minimum 1.7 oz/sq ft galvanized coating to ASTM A123/A123M requirements.
D. 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.
E. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

2.6 STEEL 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" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
B. High-Strength Bolts, Nuts, and Washers: ASTM A 325 ASTM A 325M, Type 1, heavy hex steel struc-tural bolts; ASTM A 563 ASTM A 563M heavy hex carbon-steel nuts; and ASTM F 436 ASTM F 436M hardened carbon-steel washers.
   1. Finish: Plain Hot-dip zinc coating, ASTM A 153/A 153M, Class C; Mechanically deposited zinc coating, ASTM B 695, Class 50.
C. Welding Electrodes: Comply with AWS standards.
D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.7 SOURCE QUALITY CONTROL

A. Provide shop testing of steel components as follows:
B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10% percent of bolts at each connection.
C. Welded Connections: Visually inspect all shop-welded connections and test at least 10 percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94/E94M.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 ERECTION

A. Erect joists with correct bearing on supports.
B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
E. Position and field weld joist chord extensions and wall attachments as detailed.
F. Install supplementary framing for floor and roof openings greater than 18 inches.

G. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
H. Do not field cut or alter structural members without approval of joist manufacturer.
I. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed , except surfaces specified not to be primed.

3.3 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10% percent of bolts at each connection.
C. Welded Connections: Visually inspect all field-welded connections and test at least 10% percent of welds using one of the following:
    1. Radiographic testing performed in accordance with ASTM E94/E94M.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acoustical roof deck.
B. Roof deck.
C. Supplementary framing for openings up to and including 10 inches..
D. Bearing plates and angles.
E. Acoustical insulation in roof deck flutes and end dams.

1.2 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing.
B. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
C. Section 04 20 00 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
D. Section 05 12 00 - Structural Steel Framing: For shop- and field-welded shear connectors.
E. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
F. Section 05 21 00 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.
G. Section 05 50 00 - Metal Fabrications: For framing deck openings with miscellaneous steel shapes.
H. Section 09 90 00 - Paints, High Performance Paints, Stains, and Coatings.
I. Section 26 05 33.16 - Boxes for Electrical Systems: Electrical, telephone, floor outlets, sleeves, and gaskets.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
D. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Errata (2026).
F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2025, with Errata (2026).
G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
H. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
J. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittals procedures.
B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
D. Certificates: Certify that products furnished meet or exceed specified requirements.
E. Submit manufacturer's installation instructions.
F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
G. Product Certificates: For each type of steel deck.
H. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
    1. Power-actuated mechanical fasteners.
I. Evaluation Reports: For steel deck, from ICC-ES.

J. Designer's Qualification Statement.

K. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.5 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

C. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

D. Store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 MANUFACTURERS

A. Steel Deck: 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. Canam Steel Corporation: www.canam-steeljoists.ws.
2. Epic Metals Corp.: www.epicmetals.com/
3. New Millennium Building Systems: www.newmill.com/#sle.
4. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.

1. Calculate to structural working stress design and structural properties specified.

B. Acoustical Roof Deck: Non-composite type, steel sheet with plain vertical flute faces perforated with 1/8 inch diameter holes staggered 3/8 inch on center:

1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 40/275, with G90/Z275 galvanized coating.
   a. Grade as required to meet performance criteria.
2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
3. Structural Properties:
   a. Span Design: Multiple.
4. Minimum Base Metal Thickness: As indicated in the drawings.
5. Nominal Height: As indicated in the drawings.
6. Profile: As indicated in the drawings.

7. Formed Sheet Width: 24 inch.
8. Side Joints: Lapped, mechanically fastened.
9. End Joints: Lapped, mechanically fastened.

C. Roof Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 40/275, with G90/Z275 galvanized coating.
a. Grade as required to meet performance criteria.
2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
3. Deck Profile: As indicated in the drawings.
4. Profile Depth: As indicated in the drawings.
5. Design Uncoated-Steel Thickness: As indicated in the drawings.
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped.
8. Structural Properties:
a. Span Design: Multiple.
9. Nominal Height: As indicated in the drawings.
10. Profile: Fluted; SDI WR.
11. Formed Sheet Width: 36 inch.
12. Side Joints: Lapped, mechanically fastened.
13. End Joints: Lapped, mechanically fastened.

2.4 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
B. Welding Materials: AWS D1.1/D1.1M.
C. Fasteners: Galvanized hardened steel, self tapping.
D. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM) design method for roof deck and floor deck applications.
2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B633, SC1, Type III zinc electroplate.
3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
4. Products:
a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.
E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.
I. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.
J. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
K. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
L. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
M. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

N. 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.

O. 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 recommended by SDI Publication No. 31 for overhang and slab depth.

P. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

Q. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

R. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

S. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

T. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

2.5 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, 20 gauge, 0.0359 inch thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, 14 gauge, minimum thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

D. Floor Drain Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports per methods indicated on drawings.

1. Welding: Use fusion welds through weld washers.
2. Place and secure special deep fluted sections for integral concrete bridging.

E. Clinch lock seam side laps.

F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.

G. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

H. Weld deck in accordance with AWS D1.3/D1.3M.

I. At deck openings greater than 6 inches in size, provide steel angle reinforcement. as specified in Section 05 12 00 and as indicated in the plans.

J. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

L. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
M. Close openings with single row of foam cell closures.
N. Place metal cant strips in position and fusion weld.
O. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
P. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
Q. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
R. Install temporary shoring before placing deck panels if required to meet deflection limitations.
S. Locate deck bundles to prevent overloading of supporting members.
T. 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.
U. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
V. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
W. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
X. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
Y. 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 as indicated :
    1. Weld or Fastener Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds or fasteners as indicated.
    2. 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 one-half of the span or 18 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 2 inches minimum.
D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld 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.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Field welds will be subject to inspection.
C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 09 90 00 - Paints, High Performance Paints, Stains, and Coatings.

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 90 00 - Paints, High Performance Paints, Stains, and Coatings.

END OF SECTION 05 31 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.
B. Steel framing and supports for overhead doors.
C. Steel tube reinforcement for low partitions.
D. Steel framing and supports for mechanical and electrical equipment.
E. Steel framing and supports for applications where framing and supports are not specified in other Sections.
F. Metal ladders.
G. Metal guardrail on mezzanine.
H. Miscellaneous steel trim.
I. Products furnished, but not installed, under this Section include the following:
    1. Loose steel lintels.
    2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
    3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
C. Section 04 72 00 Cast Stone Masonry: Placement of metal fabrication in masonry.
D. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
E. Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
F. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
G. Section 09 90 00 - Paints, High Performance Paints, Stains, and Coatings: Paint finish.

1.3 ALTERNATE

A.

1.4 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.
B. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
C. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
D. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
F. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
G. 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; 2025.
H. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2025.
I. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2025.

J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
K. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
L. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2023.
M. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025a.
O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Errata (2026).
Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
T. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
U. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.5 COORDINATION

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

1.6 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
C. Designer's Qualification Statement.

1.7 QUALITY ASSURANCE

A. Design ladders under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
    1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 MATERIALS - STEEL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Sections: ASTM A36/A36M.
C. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
D. Plates: ASTM A283/A283M.
E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
F. Stainless Steel, General: ASTM A666/A666M, Type 304.
G. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
H. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
I. Slotted Channel Fittings: ASTM A1011/A1011M.
J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
    1. Size of Channels: 1-5/8 by 1-5/8 inches.
    2. Material: ASTM A653/A653M, Grade 33, with standard coating.
K. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
L. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1.
M. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
N. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
O. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.3 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
G. Bolts, Nuts, and Washers: Stainless steel.
H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
    1. Provide stainless steel fasteners for fastening stainless steel.
    2. Provide stainless steel fasteners for fastening aluminum.
B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563/A563M; and, where indicated, flat washers.
C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
D. Eyebolts: ASTM A 489.
E. Machine Screws: ASME B18.6.3.
F. Lag Screws: ASME B18.2.1.
G. Wood Screws: Flat head, ASME B18.6.1.
H. Plain Washers: Round, ASME B18.22.1.
I. Lock Washers: Helical, spring type, ASME B18.21.1.
J. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.
    1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

K. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

L. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

M. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI (APL)#79 and compatible with topcoat.

D. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Fabricate items with joints tightly fitted and secured.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Continuously seal joined members by intermittent welds and plastic filler.

G. 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.

H. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

I. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

1. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

L. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

M. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

N. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.9 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.

B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

C. Lintels: As detailed; galvanized finish.

D. Sill Angles for Tempered Glass Railing Assemblies: ASTM A36/A36M steel angles with anchoring devices and sizes as indicated in shop drawings for railing assembly, drilled and tapped for fastener types, sizes, and spacing indicated, prime paint finish.

E. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

F. Recessed Mat Frames : As detailed; steel, galvanized finish.

G. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

H. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

I. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.10 METAL LADDERS

A. General:
1. Comply with ANSI A14.3.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:
1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.

C. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
1. Rungs: 1-inch- (25-mm-) diameter steel bars.
2. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
3. Provide nonslip surfaces on top of each rung.
4. Galvanize exterior ladders, including brackets.

5. Prime ladders, including brackets and fasteners, with zinc-rich primer.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, 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.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

2.13 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 FINISHES - STEEL & IRON

A. Prime paint steel items.

1. Exceptions: Galvanize items indicated to be galvanized on the drawings, items to be embedded in concrete and items to be embedded in masonry.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Spangles must be 5mm or less in all applications.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

H. Stainless Steel Finish: No. 4 Bright Polished finish.

2.15 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I color anodized.

B. Interior Aluminum Surfaces: Class I natural anodized.

2.16 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. Field Welding: Comply with the following requirements:
    1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    2. Obtain fusion without undercut or overlap.
    3. Remove welding flux immediately.
    4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
G. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
H. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
I. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
    1. Extruded Aluminum: Two coats of clear lacquer.v
J. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.4 REPAIRS

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

3.5 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 50 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formed steel stud exterior wall and interior wall framing.
B. Formed steel joist framing and bridging.
C. Ceiling joist framing.
D. Soffit framing.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Veneer mansonry supported by wall stud metal framing.
B. Section 04 72 00 - Cast Stone Masonry: Stone veneer suppoerted on wall stud metal framing.
C. Section 05 50 00 Metal Fabrications: for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
D. Section 05 31 00 - Steel Decking.
E. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
F. Section 07 21 00 - Thermal Insulation: Insulation within framing members.
G. Section 07 62 00 - Sheet Metal Flashing and Trim: Head and sill flashings.
H. Section 09 22 16 - Non-Structural Metal Framing:for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.
I. Section 09 51 00 - Acoustical Ceilings: Ceiling suspension system.

1.3 DEFINITIONS

A. General: See AISI S240 for definitions of terms used in this section.
B. Connection: A combination of structural elements and joints used to transmit forces between two or more members.
C. Connector: A device used to transmit forces between cold-formed steel structural members or between a cold-formed steel structural member and another structural element.

1.4 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2025.
H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2025, with Errata (2026).
K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.
B. Coordinate stud location, along with minimun size and gauge with approved exterior rainscreen facade backup system and support.

C. Preinstallation Meeting: Conduct a preinstallation meeting 10 days prior to the start of the work of this section; require attendance by affected installers.

1.6 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide data on cold-formed steel structural members; include material descriptions and base steel thickness for the following:
   1. Cold-formed steel framing materials.
   2. Vertical deflection clips.
   3. Single deflection track.
   4. Double deflection track.
   5. Post-installed anchors.
   6. Power-actuated anchors.
C. Product Data: Provide manufacturer's data on factory-made connectors and mechanical fasteners, showing compliance with requirements.
D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
E. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
   2. Submit current documentation of contractor accreditation and installer certification. Keep copies of each on-site during and after installation, and present upon request.
F. Design Data:
   1. Shop drawings signed and sealed by a professional structural engineer.
   2. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a professional structural engineer.
   3. Details and calculations for factory-made connectors, signed and sealed by a professional structural engineer.
G. Evaluation Service Reports: Provide reports indicating compliance with specified requirements for cold-formed steel structural members, connectors, and mechanical fasteners.
H. Inspection Reports: Provide material verification Inspection Reports in accordance with requirements of AISI S240.
I. Designer's Qualification Statement.
J. Manufacturer's Qualification statement.
K. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before the start of scheduled welding work.
L. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.
M. SSFSA Manufacturer Qualification: Submit documentation of manufacturer association membership.

1.7 QUALITY ASSURANCE

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.
C. Manufacturer Qualifications:
   1. SFIA Code Compliance Certification Program: www.CFsteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.
   2. Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
   3. Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.
D. Professional Contractor and Truss Fabricator Qualifications: SFIA-accredited contractor and fabricator: www.CFsteel.org/#sle.

E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.1 MANUFACTURERS SUBJECT TO COMPLIANCE WITH REQUIREMENTS, AVAILABLE MANUFACTURERS OFFERING PRODUCTS THAT MAY BE INCORPORATED INTO THE WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

A. Structural Framing:
   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. MRI Steel Framing: www.mristeelframing.com/#sle.
   6. SCAFCO Corporation: www.scafco.com/#sle.
   7. Steel Construction Systems: www.steelconsystems.com/#sle.
   8. Super Stud Building Products, Inc: www.buysuperstud.com/#sle.
   9. Telling Industries: www.tellingindustries.com/#sle.
   10. The Steel Network, Inc: www.SteelNetwork.com/#sle.
   11. Substitutions: See Section 01 60 00 - Product Requirements.

B. Connectors:
   1. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. MarinoWARE: www.marinoware.com/#sle.
   3. MKT Fastening; Post-Installed Mechanical Anchors: www.mktfasteningusa.com/#sle.
   4. MRI Steel Framing: www.mristeelframing.com/#sle.
   5. Simpson Strong-Tie: www.strongtie.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," **to design all cold-formed metal framing**.

B. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with applicable building code.

C. Design Criteria: In accordance with applicable codes and As indicated on the drawings.
   1. Live load deflection meeting the following, unless otherwise indicated:
      a. Floors: Maximum vertical deflection under live load of 1/480 of span.
      b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
      c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
   2. Seismic Criteria: Comply with ASCE 7 and with local authorities having jurisdiction:
      a. Site Class: D.
      b. Seismic Design Category: D.
   3. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   4. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.3 MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 90 in accordance with AISI S240.

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, subject to the ductility limitations indicated in AISI S240.
1. Structural Grade: 33.
2. Corrosion Protection Coating Designation: CP 60 (G60, A60, or AZ50) in accordance with AISI S240.

2.4 STRUCTURAL FRAMING COMPONENTS

A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.
3. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.
4. Provide components fabricated from ASTM A1011/A1011M Designation SS (structural steel).

B. Jamb Studs: AISI S240; manufactured, engineered, c-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 90 in accordance with AISI S240.
3. Thickness and Depth: Depth as indicated on drawings; thickness and structural grade as required to meet specified design criteria.

C. Headers: AISI S240; manufactured, engineered one-member or two-member assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 90 in accordance with AISI S240.
3. Thickness and Depth: Depth as indicated on drawings; thickness and structural grade as required to meet specified design criteria.
4. Jamb Mounting Clips: Manufacturer's standard.
5. Cripple Stud Clips: Manufacturer's standard.

D. Joists: AISI S240; manufactured, engineered open-web steel joists.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 90 in accordance with AISI S240.

2.5 CONNECTIONS

A. Performance Requirements: Provide connections in compliance with requirements of AISI S240.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: CP 90 in accordance with AISI S240.

C. Structural Performance: Maintain load and movement capacity required by applicable building code and specified design criteria.

D. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
1. Where continuous studs bypass elevated roof deck, connect stud to deck in manner allowing vertical and horizontal movement of deck without affecting studs; allow for minimum movement of 1/2 inch.
2. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch below perimeter steel beams and 1-1/2” at long span bar joists. Allow for these deflection amounts AFTER all roof dead load is in place (ceilings excepted).
3. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.

4. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.

E. Fixed Connections: Provide nonmovement devices for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

F. Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connectors where indicated on the drawings.

G. Vertical Deflection Clips, Exterior: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

H. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 MISCELLANEOUS CONNECTIONS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: As indicated on the drawings..

C. Welding: Comply with AWS D1.1/D1.1M.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554 Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI CODE-318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation 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. Stud kickers and knee braces.
8. Joist hangers and end closures.
9. Hole reinforcing plates.
10. Backer plates.

C. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

D. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.

E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.9 FABRICATION

A. Fabricate cold-formed steel 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.
B. Fabricate framing assemblies using jigs or templates.
C. Cut framing members by sawing or shearing; do not torch cut.
    1. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
        a. Comply with AWS D1.3/D1.3M 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 screws penetrating joined members by no fewer than three exposed screw threads.
D. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
E. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
F. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable 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 are not to exceed minimum fastening requirements of sheathing or other finishing materials.
    2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Verify field measurements and adjust installation as required.

3.2 PREPARATION

A. Structural Wall Foundations: For gaps between wall bottom track and top of foundation 1/4 inch or greater, level substrate with loadbearing shims or grout between track and foundation.

3.3 INSTALLATION - GENERAL

A. Install structural members and connections in compliance with ASTM C1007.
B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.4 INSTALLATION OF STUDS

A. Install wall studs plumb and level.
B. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
C. 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 steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
E. Cut framing members by sawing or shearing; do not torch cut.
    1. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

F. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
G. Install temporary bracing and supports to secure framing and support loads equal 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.
H. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
I. Install insulation in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
J. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
K. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
L. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
M. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.
N. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
O. Install intermediate studs above and below openings to align with wall stud spacing.
P. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.
Q. Attach cross studs to studs for attachment of fixtures anchored to walls.
R. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
S. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.

3.5 INSTALLATION OF JOISTS AND PURLINS

3.6 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Provide material verification inspections in accordance with requirements of AISI S240.
C. Provide inspections for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.
D. Coordination of Other Tests and Inspections: Owner will employ independent testing agency to test and/or inspect cold-formed steel light-framing construction; provide access as required to accommodate timely performance.
E. Testing agency will report test results promptly and in writing to Contractor and Architect.
F. Cold-formed steel framing 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.

3.7 TOLERANCES

A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft, in accordance with ASTM C1007.
B. Studs - Maximum Variation from True Position: 1/8 inch in accordance with ASTM C1007.
C. Stud Spacing: 1/8 inch from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.
D. Maximum Variation from True Position: 1/8 inch.
E. Maximum Variation of any Member from Plane: 1/8 inch.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.
3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; [unfinished] [coated with rust-inhibitive, baked-on, acrylic enamel] [hot-dip galvanized after fabrication].

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; 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, all hot-dip galvanized per ASTM F 2329.

C. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, 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.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Cap bollards with 1/4-inch- thick steel plate.

B. Prime bollards with zinc-rich primer.

2.9 GUARDS

A. Fabricate guards from 3/8-inch- thick by 12-inch- wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.12 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES

A. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. 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.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheathing.
B. Communications and electrical room mounting boards.
C. Miscellaneous wood nailers, furring, and grounds.
D. Wall sheathing with factory applied water-resistive and air barrier sheet.
E. Wall sheathing with facotry applied insulation board.

1.2 RELATED REQUIREMENTS

A. Section 06 17 53 - Shop-Fabricated Wood Trusses.
B. Section 06 40 23 - Interior Architectural Woodworking.
C. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.
E. Section 09 73 00 - Wood Wall Panels.
F. Section 10 28 00 - Toilet, Bath and Laundry Accessories: Reinforcement.

1.3 ALTERNATE

A. Alternate: Refer to Division 01 Section “Alternates” for alternates which include work of this Section. Alternate work includes, but is not limited to the following:
   1. Alternate No. 1: Wood Slat Wall and Ceiling.

1.4 DEFINITIONS

A. Dimensional Lumber: Lumber of **two (2) inches** nominal or greater, but less than **five (5) inches** nominal in least dimension.
B. Boards or Strips: Lumber of less than two (2) inches nominal size in least dimension.
C. Exposed Framing: Framing not fully concealed by other construction.
D. OSB: Oriented strand board.
E. Timber: Lumber of **five (5) inches** nominal size or greater in least dimension.
F. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. SPIB: The Southern Pine Inspection Bureau.
   4. WWPA: Western Wood Products Association.

1.5 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 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; 2026.
D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
E. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2025.
F. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
G. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-Bonded to Wood-Based Structural Sheathing, Used as Water-Resistive Barriers; 2008, with Editorial Revision (2021).
H. PS 1 - Structural Plywood; 2023.
I. PS 2 - Performance Standard for Wood Structural Panels; 2019.

1.6 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide technical data on application instructions and sheathing with factory laminated water-resistive barrier layer.

C. Product Data: Submit technical data on wood treatment.
D. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
E. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.
B. Moisture Content: S-dry or MC19.
C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 3 or Utility Grade.
   2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

A. Roof Sheathing: Plywood wood structureal panel; PS 1
   1. Grade: Structural 1 Sheathing
   2. Bond Classification: Exposure 1.
   3. Span Rating: 40/20.
   4. Performance Category: 5/8 PERF CAT.
   5. Edges: Square with H-clips at unsupported panel edges between framing members.
   6. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 200 days.
   7. **Provide fastening guide on top panel surface** with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
   8. **Warranty:** Manufacturer's standard limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
B. Wall Sheathing: Oriented strand board, structural wood panel with water-resistive barrier.
   1. Sheathing Panel: PS 2, Exposure 1.
      a. Size: 4 feet wide by 8 feet long.
      b. Grade: Sheathing.
      c. Performance Category: 5/8 PERF CAT.

d. Span Rating: 40/20.
e. Edge Profile: Square edge.

2. Integral Water-Resistive Barrier: Sheet material qualifying as a Grade D water-resistive barrier; complying with ICC-ES AC310.
3. Water Vapor Permeance of Water-Resistive Barrier: 12 to 16 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B.
4. Maximum Allowable Air Leakage of Assembly: Comply with ASTM E2357.
   a. Infiltration: 0.0072 cfm/sq ft, maximum, at a pressure differential of 1.57 psf.
   b. Exfiltration: 0.0023 cfm/sq ft, maximum, at a pressure differential of 1.57 psf.
5. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
6. Seam Tape: Manufacturer's standard pressure-sensitive, self-adhering, cold-applied, seam tape.
7. Warranty: Manufacturer's standard 30 year limited system warranty.
   a. Performance: Panel and tape resistance to water penetration; tape adhesion.
   b. Material: Free from manufacturing defects and panel delamination.
8. Basis of Design Product: Provide the following or a comparable manufacturer, subject to compliance with the requirements of this specifcation and approved by the Architect
   a. Huber Engineered Woods, LLC; ZIP System Roof/Wall Sheathing and ZIP System Seam Tape: www.huberwood.com/#sle.

C. Wall Sheathing: Wood construction panel laminated to insulation board - "Composit nailbase insulation wall panels".
   1. Reference Section 07 21 00 Thermal Insulation.
D. Communications and Electrical Room Mounting Boards: PS 1 A-C plywood, 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

A. Metal and Finish of Fasteners:
   1. Untreated Wood: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
   2. Masonry Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
B. Sill Flashing: See Section 07 62 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.
B. Coordinate installation of rough carpentry members specified in other sections.

3.2 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.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 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.

3.4 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 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.
D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
E. Provide nonstructural framing and blocking to support the following:
    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. Other wall- or ceiling-mounted items indicated on drawings.

3.5 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
    1. Nail panels 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, screws, or staples.
C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
    1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
    2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
    3. Install adjacent boards without gaps.
    4. Size: 48 by 96 inches, installed horizontally at ceiling height.
D. Wall Sheathing and Roof Sheathing with Laminated Water-Resistive Barrier and Air Barrier: Secure to studs in accordance with manufacturer's installation instructions.
    1. Install with laminated water-resistive and air barrier on exterior side of sheathing.
    2. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3. Use only mechanically attached and drainable EIFS and exterior insulation with wall sheathing with laminated water-resistive and air barrier.
4. Apply manufacturer's standard seam tape to joints between sheathing panels; use tape gun or hard rubber roller in accordance with manufacturer's installation instructions.

3.7 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.
B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.9 CLEANING

A. Waste Disposal: See Section 01 74 19 - 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 06 10 00

This page intentionally left blank

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets that are not concealed within other construction.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
Shop Drawings: For plastic-laminate-faced architectural cabinets.

1. Include plans, elevations, sections, and attachment details.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.
Grade: Premium.

C. Type of Construction: Frameless

D. Door and Drawer-Front Style: Flush overlay
Reveal Dimension: 1/2 inch

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:
Horizontal Surfaces: Grade HGS

2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Formica 5883-58 Pecan Woodline, Matte
   a. Location: Community Room & Student Space
2. Formica Deco Metal, Copper Veil
   a. Location: Men’s & Women’s Restrooms

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
Wood Moisture Content: 5 to 10 percent.

Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

General: Provide cabinet hardware and accessory materials associated with architectural cabinets

B. Hinges:

1. Hinges for Flush Doors:Salice C2R9A99 Steel, Nickle Plated, 120 degree, Full Overlay, Self Closing, Hafele Item 329.03.558.
2. Hinges for Overlay Doors (1 3/8" to 1 3/4" thick doors not exceeding 150 lbs.): Stanley 327 (ANSI A8782), Heavy Weight, Steel, Satin, Chrome (26D) Plated.

C. Plates:

1. Hinge Plate to Self Closing or Free Swing Hinges: Salice BARGR29/16, 2mm Offset, Euroscrew Premounted, Zince, Die Cast, Cam Adjustable, Hafele Item 329.72.512

D. Pulls:

1. Mockett DP3C – 6" long Tab Drawer Pull, 1 ½"
   a. Install Front Mount (a)
      1) Do **not** install Front Surface Mount (c)
   b. Finish: Satin Chrome

2. Catch to hold large doors closed: Magnetic Catch, Ives Supermite 327, Aluminum

E. Bumpers:

1. Hafele 356.25.400 Door Stop Plastic, Clear, 12.7 x 3.5mm

F. Brackets:

1. Bracket to Support Countertops: A&M Hardware Work Station Brackets, Black 8x12

G. Adjustable Shelf Standards and Supports:

1. KV Standard: Hafele 774.20.267 KV 87 Anochrome 72"
2. KV Bracket: Hafele 774.24.282 KV 187 Anochrome 20"
3. KV Clip Shelf Stabilizer: Hafele 774.26.282 KV 211 Ano Chrome Center Shelf Rest Clip for KV 187 Brackets

H. Drawer Slides (where applies):

1. Drawer Slide for Typical Drawers: Accuride 3832ESC Light-Duty Full-Extension Slide with Self-Close Lever-Disconnect and Zinc Finish
2. Drawer Slide for Pull Out Trash: Accuride C3600-200D Heavy-Duty Full-Extension and Self-Closing Slide with Platform-Mount, Zinc Finish
3. Drawer Slide for Wide Drawers: Accuride 3160EC Commercial-Grade & Soft-Close Undermount Slide for Ultra-Wide Drawers
4. Wide Drawer Stabilizer Kit: Accuride 4180-0753-XE for use with 3160EC Slide

I. Zee Clips and Bars:

1. Zee Clips and Bars for Hanging Overhead Storage: Monarch MF375 2" Clip and Bar Solid Aluminum

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

D. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces

2.5 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

B. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

END OF SECTION

SECTION 07 14 00 - FLUID-APPLIED WATERPROOFING / DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cold Fluid-Applied waterproofing and dampproofing.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Insulation used for protective cover and drainage panels.
B. Single source supplier must supply compatible products under all related sections below or provide compatibility testing for materials that connect to or come in contact with the product being provided:
   1. Section 07 14 00 "Fluid-Applied Waterproofing / Dampproofing."
   2. Section 07 21 00 “Thermal Insulation” for insulation."
   3. Section 07 24 19 “Exterior Insulation & Finish System (EIFS)” for the air barrier and detail membranes within this system.
   4. Section 07 27 26 “Fluid-Applied Membrane Air Barriers.”
   5. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.

1.3 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
B. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
C. ASTM C898/C898M - Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Separate Wearing Course; 2017.
D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
E. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
F. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.
G. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application; 2024.
H. ASTM D4263 - Standard Practice for Indicating Moisture in Concrete by the Plastic Sheet Method; 2024.
I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
J. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
C. Shop Drawings:
   1. Show locations and extent of waterproofing / damproofing.
   2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
   3. Indicate special joint or termination conditions and conditions of interface with other materials.
D. Product Certificates: For cold-fluid-applied waterproofing, certifying compatibility of waterproofing materials with Project materials that connect to or that come in contact with the barrier; signed by the product manufacturer. Or provide compatibility testing for materials that connect to or come in contact with product being provided. The list of products requiring compatibility includes but is not limited to:
   1. Fluid-applied membrane air barriers, transition strips, flashings and sealants.
   2. Joint Sealants.
   3. Thermal insulation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.
C. Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
    1. Construct mock-up consisting of 100 sq ft of horizontal and vertical fluid-applied waterproofing; to represent finished work including internal and external corners, control joints, expansion joints, and counterflashings.
    2. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Architect specifically accepts such deviations in writing.
    3. Subject to compliance with requirements, accepted mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.
B. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than **5 degrees F** above dew point.
C. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer's Special Warranty: Provide **10-year** warranty for waterproofing failing to resist penetration of water commencing on Date of Substantial Completion. Complete forms in Owner's name.
C. Installer Warranty: Provide 2-year warranty for waterproofing failing to resist penetration of water commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitation for Waterproofing / Dampproofing and Fluid-Applied Membrane Air Barriers: Obtain waterproofing / dampproofing and Fluid-Applied Membrane Air Barriers Barriers from the same manufacturer.
B. Cold Fluid-Applied Waterproofing / Dampproofing:
    1. **Basis-of-Design Product:** Provide Tremco Commercial Sealants & Waterproofing; TREMproof 260 : www.tremcosealants.com/#sle or comparable product approved by the Architect by one of the following:
        a. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/#ste.
        b. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
        c. Henry Company: www.henry.com/#ste.
    2. Substitutions: See Section 01 60 00 - Product Requirements.
C. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.2 COLD FLUID-APPLIED WATERPROOFING / DAMPPROOFING MATERIALS

A. Cold Fluid-Applied Waterproofing / dampproofing: polymer-enhanced, single component, fluid-applied, asphalt emulsion, below-grade waterproofing / dampproofing membrane.
    1. Cured Thickness: 60 mil, 0.060 inch, minimum.

2. Suitable for installation over concrete substrates.
3. Elongation: 800 percent, minimum, measured in accordance with ASTM D412.
4. VOC Content: No more than 72 g/L
5. Hardness, ASTM D 2240: 50 minimum; Pass.
6. Low Temperature Crack Bridging, ASTM C836; Modified ASTM C1305: Pass.
7. Adhesion-in-Peel after Water Immersion, ASTM C836; ASTM C794: Exceeds.
8. Peel adhesion, ASTM D903: Passes
9. Low-Temp Flexibility, ASTM C836: Pass.
10. Water resistance, ASTM C836, AATC-127: Pass
11. Water Vapor Permeance E96 Dry Cup: 0.028 US Perms
12. Water Vapor Permeance E96 Wet Cup: 0.032 US Perms
13. Stability (80°F/26.7°C): 6 months Minimum 1 year
14. Solids 64%, Density 8.1 lb/gal

2.3 ACCESSORIES

A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete waterproofing system meeting performance requirements, and compatible with waterproofing material and adjacent materials.
B. Elastomeric Detail Sheet: Blended thermoset elastomeric sheet reinforced with polyester woven scrim.
   1. Basis of Design Product: Tremco, TRA Elastomeric Sheeting.
C. Joint Sealant: ASTM C 719, high performance, medium-modulus, low-VOC, UV-stable, non-sag polyurethane sealant approved by waterproofing manufacturer for adhesion and compatibility with waterproofing and accessories.
   1. Basis of Design Product: Tremco, Dymonic 100.
   2. Basis of Design Product: Tremco, TREMproof 260.
D. Expansion Joint Pre-compressed or Closed Cell, Monolithic Foam System. Foam Structure Must not Contain Unbonded Foam Laminations;
   1. Willseal® Coreseal for use in both vertical and horizontal below grade system applications requiring +/-25% movement capability, closed cell, and a lightweight seal.
   2. Willseal® Color Coreseal for use in both vertical and horizontal below grade system applications requiring +/-25% movement capability, closed cell, and a lightweight seal.
   3. Willseal® Color Coreseal – CM for use in both vertical and horizontal below grade Tremco system applications requiring +/-25% movement capability, closed cell, and a lightweight seal with an integrated waterproofing membrane.
   4. Willseal® 250 BG for use in below grade applications, requiring +/- 50% movement capability

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
C. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
D. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
E. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
F. Verify that items penetrating surfaces to receive waterproofing are securely installed.
G. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
H. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 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.
   1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate in accordance with ASTM D4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces in accordance with ASTM D4258.
C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
E. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.
   1. Comply with ASTM C1193 for joint-sealant installation.
   2. Apply bond breaker on sealant surface, beneath preparation strip.
   3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
F. Install sheet flashing and bond to deck and wall substrates where required in accordance with waterproofing manufacturer's written instructions.
   1. Extend sheet flashings for 4 inches onto perpendicular surfaces and items penetrating substrate.
G. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M.
   1. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
H. Install cant strips at inside corners.

3.3 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions, NRCA (WM), and ASTM C898/C898M applicable requirements.
B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
C. Start installing waterproofing in presence of manufacturer's technical representative.
D. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.
E. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
   1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils.
   2. Apply waterproofing to prepared wall terminations and vertical surfaces.
   3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft..
F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.
G. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
   1. For horizontal applications, install protection course loose laid over fully cured membrane.
   2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
   3. Thermal insulation specified in Section 07 21 00 - Thermal Insulation may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Owner will provide testing and inspection services, and Contractor to provide temporary construction and materials for testing.
C. Waterproofing will be considered defective if it does not pass inspections.
D. Prepare inspection reports.

3.5 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.
B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 07 14 00

This page intentionally left blank

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at cavity wall construction, underside of floor slabs, and exterior wall behind metal wall panels.`
B. Batt insulation in exterior wall construction.
C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
D. Spray polyurethane foam insulation
E. Composite Nailbase Insulation Wall Panels.

1.2 RELATED REQUIREMENTS

A. Section 07 54 00 - Thermoplastic Membrane (TPO) Roofing: For board insulation used on the roof deck.
B. Section 09 21 16 - Gypsum Board Assemblies: For sound attenuation blacket used in acoustic insulation for interior walls.
C. Single source supplier must supply compatible products under all related sections below or provide compatibility testing for materials that connect to or come in contact with the product being provided:
    1. Section 07 14 00 "Fluid-Applied Waterproofing / Dampproofing."
    2. Section 07 21 00 “Thermal Insulation” for insulation."
    3. Section 07 24 00 "Exterior Insulation & Finish System (EIFS)" for the air barrier and detail membranes within this system.
    4. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
    1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
    2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
    3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.4 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.
D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2024.
F. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.7 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation and Slab Edge: Extruded polystyrene (XPS) board.

C. Insulation Inside Masonry Cavity Walls and Metal Wall Panels: Polyisocyanurate board.

D. Insulation in Metal Framed Walls: Unfaced Batt insulation with no vapor retarder.

E. Insulation in Soffits : Closed-cell spray polyurethane foam.

F. Insulation over Roof Deck: Polyisocyanurate board. Reference Section 07 5400 Themroplastic Membrane (TPO) Roofing.

G. Composite Nailbase Insultation: Polyisocyanurate

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation (At perimeter horizontal insulation locations under slab and At perimeter vertical insulation locations at slab edge and foundations): Comply with ASTM C578.

1. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type VI, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Wall Insulation Drainage Panels: Fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.
    a. Thermal resistances: 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F per inch of thickness
    b. Locations: Below-grade vertical insulation with earth against the insulation.
6. Thickness: As indicated in the drawings to achieve min. R-value of 10.
7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Chemical Company (The).
    b. Ownern Corning.
    c. Johns Manville.
    d. ROCKWOOL
    e. Thermafiber, Inc.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam (At masonry cavities and behind metal wall panels) comply with ASTM C1289.

1. Classifications:
    a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.

1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of core foam.
2) Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F.

2. Thickness: As indicated in the drawings.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Atlas Roofing Corporation; www.atlasroofing.com
   b. Carlisle Coatings & Waterproofing; www.carlisleccw.com
   c. Johns Manville; www.jm.com
   d. Rmax, Inc; www.rmax.com

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS (BATT)

A. Unfaced, Glass-Fiber Blanket Insulation (concealed in exterior metal framed walls and other areas on the exterior as indicated on the drawings): ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
   1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
   3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
   4. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
   5. Thickness: as indicated in the drawings.
   6. Manufacturers:
      a. CertainTeed Corporation; Saint-Gobain North America.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Owens Corning.

2.4 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
   1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
   3. If exposed: Apply fire retardant coating equal to DC315 by International Fireproof Technology Inc.
      a. Install per manufacturer’s recommendation to meet NFPA 286.
   4. Provide application for an average final thickness/depth for a minimum of a R-12 insulation value for walls
   5. Provide application for an average final thickness/depth for a minimum of a R-30 insulation value for soffits.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. BASF Corporation.
   2. cynene, Inc.
   3. BaySystems NorthAmerica, LLC.
   4. Dow Chemical Company (The).
   5. ERSystems, Inc.
   6. Gaco Western Inc.
   7. Henry Company.

8. NCFI; Division of Barnhardt Mfg. Co.
9. SWD Urethane Company.
10. Volatile Free, Inc.

2.5 COMPOSITE NAILBASE INSULATION WALL PANELS

A. Board Insulation Bonded to Plywood equal to Hunter Panels Xci Ply Class A, or equal with the following characteristics:
   1. A high thermal resistive rigid insulation panel composed of a closed cell polyisocyanurate foam core bonded to a premium performance coated glass facer on one side and bonded to fire retardant treated plywood on the other side.
   2. Type: ASTM C 1289, Type V.
   3. Foam Core: Grade 2 (20 psi).
   4. Fire Retardant Treated Plywood Thickness: 5/8 inch.
   5. Panel Size: 4 feet by 8 feet.
   6. Thickness /R Value: Based on ASTM C 518 at 75 degrees F: 2.6 inches / R Value 12.9 with 5/8 inch plywood facing.
   7. ALL JOINTS TO BE FORMED IN PLACE with expanding spray foam per manufacturer's recommendation.
   8. Installation per manufacturer's written recommendations.

2.6 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer for application.
   1. Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGM Industries, Inc; www.amgindustries.com
      b. Gemco; www.okgemco.com
   2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
C. Insulation for Miscellaneous Voids:
   1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
D. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Comply with insulation manufacturer's written instructions applicable to products and applications.
B. Install boards in an orientation as recommended by manufacturer on foundation perimeter.
   1. Butt edges and ends tightly to adjacent boards and to protrusions.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

D. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
   1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
   2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
   3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
   4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
   5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards in orientation as recommended by manufacturer on walls.
B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION AT CAVITY WALLS

A. Install boards to fit snugly between wall ties.
B. Install boards horizontally on walls.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.5 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.
B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.6 MINERAL FIBER BLANKET INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.
B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
E. Retain insulation batts in place with spindle fasteners at 12 inches on center where cavity heights exceed 96 inches.

3.7 INSTALLATION OF FOAMED-IN-PLACE INSULATION

A. General for Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
B. Comply with insulation manufacturer's written instructions applicable to products and applications.
C. Spray insulation to envelop entire area to be insulated and fill voids.
D. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
E. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
F. Cavity Walls: Install into cavities to thickness indicated on Drawings.
G. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.8 INSTALLATION OF COMPOSITE NAILBASE INSULATION WALL PANELS

A. ALL JOINTS TO BE FORMED IN PLACE with expanding spray foam per manufacturer's recommendation.
B. Install in accordance with manufacturer's instructions.

3.9 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.10 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

SECTION 07 21 63 - FLUID APPLIED INSULATIVE COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Spray-applied insulative coating including primer and insulative coating for the following applications:
   1. Applied to steel penetrating the exterior envelope without a physical thermal break, from 24 inches outboard of the face of the wall to 24 inches inside the face of metal framing.

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: for structural steel to receive fluid-applied insulation coating and coordination of steel primers with insulation coating.
B. Section 05 40 00 - Cold-Former Metal Framing: for structural steel to receive fluid-applied insulation coating and coordination of steel primers with insulation coating.
C. Section 07 21 00 - Thermal Insulation: for building insulation.
D. Section 09 90 00 - Paints, Stains, and Coatings: for painting of exposed exterior steel.

1.3 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)
   1. AISC 303-05 Section 10 – Erection and storage of coated material during shipment and site handling shall be protected to minimize field touch up.
B. American Society of Testing and Materials (ASTM)
   1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
   2. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   3. ASTM C1057 – Standard Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer.
   4. ASTM D870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
   5. ASTM D4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
   6. ASTM D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
   7. ASTM D4585 – Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
   8. ASTM D4587 – Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
   9. ASTM D4624/ISO 4624 – Standard Test Method for Bond Strength
   10. ASTM D5894 – Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet).
   11. ASTM D638 – Standard Test Method for Tensile Strength
   12. ASTM D695 – Standard Test Method for Compressive Strength
   13. ASTM D790 – Standard Test Method for Flexural Strength
   14. ASTM D2240 – Standard Test Method for Determining Durometer Hardness
   15. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   16. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
C. Association of the American Walls and Ceilings Industries (AWCI)
D. Underwriters Laboratory (UL):
   1. UL 263: Standard for Fire Tests of Building Construction and Materials.
E. The Society of Protective Coatings (SSPC)
   1. SSPC-SP6: Commercial Blast Cleaning Standard
   2. SSPC-PA1: Shop, Field, and Maintenance Painting of Steel.
   3. SSPC-PA2: Procedure for Determining Conformance to Dry Coating Thickness Requirements.

1.4 SYSTEM DESCRIPTION

A. The liquid applied thermal break acrylic material shall be applied at the required thickness specified by the manufacturer in order to mitigate thermal bridging. In no case shall the K-value of the liquid applied thermal break be more than 0.040 W/mK.

1.5 SUBMITTALS

A. See section 01 30 00 - Submittal Procedures for submittal procedures.
B. Product Data: Submit product data including manufacturers technical data indicating product performance characteristics, performance and limitation criteria.
C. Installation Details: Submit installation details prepared by the manufacturer all locations to receive fluid-applied insulation coatings.
D. Manufacturer's Instructions: Submit manufacturer written installation instructions.
E. Applicator Qualifications: Submit applicators current certification as a manufacturer trained applicator.

1.6 QUALITY ASSURANCE

A. Manufacturer:
    1. Company specializing in manufacturing product in this section with a minimum of 2 years documented experience in manufacturing insulative technology.
    2. Applicator: Company specializing in applying the work of this section with documented experience and trained by the manufacturer.
    3. Fluid Applied Thermal Break Acrylic system shall be the complete system from a sole source consisting of primer, acrylic thermal break material and topcoat. All materials shall be LEED Version 4 or Version 4.1 compliant.

1.7 MOCK-UP

A. Minimum thirty days prior to application in any area, provide mock-up Samples of thermal break materials in accordance with the following requirements:
    1. Provide minimum two square feet (.18 square meter) on representative substrate, where directed by the Engineer, for each different thickness and finish of required for the work.
    2. Provide mock-up areas that comply with thickness, density application, finish texture, and color.
    3. Inspect mock-up areas within one hour of application for variance due to shrinkage, temperature, and humidity.
    4. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary to meet required installation, finish, and color requirements.
    5. Continue to provide mock-up areas until acceptable areas are produced.
    6. Acceptable areas shall constitute standard of acceptance for method of application, thickness, finish texture, and color requirements, for fluid applied thermal break material applications.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturers' original, sealed, undamaged container with identification label intact. Packaged materials shall bear the appropriate labels, seals.
B. Storage: Materials shall be stored in strict accordance with manufacturers documented instructions.
C. Documentation: All batch number, product identification and quantities shall be recorded on appropriate QC documents. A copy of the transport document and manufacturers conformance certificate shall be attached to the material delivery on site.

1.9 FIELD CONDITIONS

A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturers' requirements.
    1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of material.
    2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.
B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before during and after application as recommended by manufacturer.

1. Do not apply Fluid Applied Acrylic Thermal Break when temperature of substrate and/or surrounding ambient air temperature is below 45° F. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during and 24 hours after material application.
2. Steel substrate temperature shall be a minimum of 5° F (3° C) above the dew point of the surrounding air for a period of 24 hours prior, during the application of the material and 24 hour cure period.
3. If necessary for job schedule, the Prime General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.
4. The relative humidity of the application area shall not exceed a maximum of 85% 24 hours prior, during and 24 hours after the application of the material. The relative humidity shall not exceed 75% throughout the application and curing of the decorative top coat finish.

PART 2 PRODUCTS

2.1 FLUID APPLIED INSULATION COATING GENERAL

A. Materials Compatibility:
   1. Provide shop and field primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   2. Provide products of same manufacturer for each coat in a coating system.

2.2 MANUFACTURERS

A. Products specified are manufactured by Tnemec Company Incorporated, 6800 Corporate Drive, Kansas City, Missouri 64120-1372, 888-698-6363, www.tnemec.com, Tbuerky@tnemec.com, and are specified as a standard of quality.
   1. Provide “Series 971 Aerolon Acrylic” fluid-applied acrylic insulation and compatible primers, or products that meet or exceed the physical and performance requirements of the specified product.

B. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.3 PRIMER COAT

A. Waterbased, Self-Crosslinking Hydrophobic Acrylic
   1. Tnemec Series 1115 Uni-Bond DF
      a. VOC Content: 131 grams/liter.
      b. Color: As selected by Architect.
      c. Requirements:
         1) Adhesion (ASTM D4541): No less than 1,472 psi.
         2) Abrasion (ASTM D4060): No more than 112 mg loss after 1,000 cycles.
         3) Impact (ASTM D2794): No visible cracking or delamination of film after 46 inch-pounds or less direct impact, average of four tests.
         4) Contrast Ration (Hiding Power) ASTM D 2805: No less than 98.80 contrast ratio using a Dataflash 650 spectrophotometer.
         5) Cyclic Salt Fog/UV Exposure (ASTM D 5894): No blistering, cracking, rusting or delamination of the film after 7,000 hours.
         6) Flexibility and Elongation (ASTM D 522): No less than 3.47% elongation, average of three tests
         7) Hardness (ASTM D 3363): No gouging with a 3H or less pencil.
         8) Humidity (ASTM D 4585): No blistering, cracking, rusting or delamination of film after 2,000 hours exposure.
         9) Light Reflectance (ASTM E 1477): No less than 85.39% luminous reflectance factor using CIE standard illuminant D 65 (daylight).

10) Salt Spray (Fog) (ASTM B 117): No more than 1/64" rust creepage at scribe, no more than 3% rusting on plane and no less than a blister rating of 8 after 500 hours exposure.
11) Surface Burning Characteristics (ASTM E 84): Classification A. No more than 10 flame spread index and no more than 15 smoke developed index, average of six tests.

2.4 THERMAL INSULATING COATING

A. Fluid Applied Acrylic Insulation Coating
1. Tnemec Series 971 Aerolon Acrylic
a. VOC Content: 1.9 grams/liter
b. Solids by Volume: 76 percent.
c. Colors: 1278 Insulation Yellow
d. Dry Film Thickness: 40.0 to 50.0 mills per coat..
e. Total Thickness: Minimum of 100.0 mils providing an R value of 0.40 unless noted otherwise.
f. Requirements:
1) Abrasion ASTM D4060: No more than 50.2 mg loss after 1,000 cycles.
2) Cyclic Salt Fog/UV Exposure ASTM D5894: No blistering, cracking, rusting or delamination of film after 5,000 hours.
3) Humidity Resistance ASTM D4585: No blistering, cracking, rusting, or delamination after 2,000 hours.
4) Immersion (ASTM D870): No blistering, cracking, rusting, or delamination after six months continuous tap water immersion.
5) Surface Burning Characteristics ASTM E84: Class A
6) Thermal Conductivity ASTM C518: No greater than 0.2468 BTU-in/ft2-hr-°F.
7) NORSOK M-501 ISO 20340: Passed 25 cycles.
8) CDPH Compliant: Passes the California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1-2010 (also known as Section 01350).

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. All surfaces to receive the specified Tnemec Series 971 Aerolon® shall follow the manufacturer’s printed instructions and be clean, dry and free of oil, grease, loose mill scale, dirt, dust or other foreign substances which would impair bond of the material to the substrate.
D. Other corrections of the surfaces to receive the Fluid Applied Insulation Coating material shall be the responsibility of the Contractor, at no additional cost to the Owner.
E. Application of the primer, Series 971 Aerolon®, and topcoat shall not commence until the contractor, applicator and inspector have examined the surfaces to receive the primer and determined the surfaces are acceptable to receive the primer and Aerolon®. Commencement of application means acceptance of substrate.
F. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturers recommendations.

3.2 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.
B. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated with thermal break coating.
C. Weld spatter and defects shall be ground smooth prior to commencement of primer and fluid applied thermal break material.

D. Primer shall not be applied to prepared substrate until the area has been adequately vented to remove all airborne dust. Prior to the application of any coating material, the blast products, dust and debris shall be removed by vacuuming.
E. Steel Substrates: Remove rust and loose mill scale.
    1. Fabrication defects:
        a. Correct steel and fabrication defects revealed by surface preparation.
        b. Remove weld spatter and slag.
        c. Round sharp edges and corners of welds to a smooth contour.
        d. Smooth weld undercuts and recesses.
        e. Grind down porous welds to pinhole-free metal.
        f. Remove weld flux from surface.
    2. Ensure surfaces are dry.
    3. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3, unless otherwise specified.
F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
    1. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.
    1. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
    2. Keep containers closed when not in use to avoid contamination.
    3. Do not use mixed coatings beyond pot life limits.
    4. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
B. Uniformly apply coatings at spreading rate required to achieve specified DFT.
C. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
D. Apply primer at thickness recommended by manufacturer.
E. Apply Series 971 Aerolon® Thermal Insulative Coating as specified in Section 3.8 Coating Schedule.
F. Final Dry Film Thickness (DFT) shall be measured with a dry film thickness gauge.
G. The steel deck is not to be sprayed unless otherwise indicated.

3.4 REPAIR

A. Materials and Surfaces Not Scheduled to Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
B. Damaged Coatings: All patching and repair to material, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage. Patching shall be performed by applicators certified by the manufacturer and applied in accordance with the manufacturer application instructions.
C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.5 CLEANING AND PROTECTION

A. Remove overspray materials from surfaces not required to be thermally protected.
B. Protect surfaces of coating systems from damage during construction.
C. Touch-up, or repair damaged products before Substantial Completion.

3.6 FLUID APPLIED INSULATION COATING SCHEDULE

A. Steel Members Penetrating Exterior Building Envelope/Inside Face of Metal Framing with a Physical Thermal Break, Condensation Control:
    1. Fluid-Applied Thermal Break System, Self-Crosslinking Hydrophobic Acrylic Primer:

a. Surface Preparation: SSPC-SP3 Power-Tool Cleaning.
b. Prime Coat (Field): Series 115 Uni-Bond DF, DFT of 2.0 to 4.0 mils per coat.
c. Intermediate Coat – Two Coats: Series 971 Aerolon Acrylic, DFT of 40.0 to 50.0 mils per coat. Total thickness of Series 971: 80 to 100 mils

END OF SECTION 07 21 63

SECTION 07 24 00 - EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Direct Applied Exterior Finish System compatible with ZIP sheathing substrate surface.
B. Soffit vent, expansion joint, and trim accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Zip Sheathing Substrate.
B. Section 07 62 00 - Sheet Metal Flashing and Trims: Perimeter flashing.
C. Section 07 92 00 - Joint Sealants: Sealing joints between EFS and adjacent construction and penetrations through EFS.
D. Single source supplier must supply compatible products under all related sections below or provide compatibility testing for materials that connect to or come in contact with the product being provided:
    1. Section 07 14 00 "Fluid-Applied Waterproofing / Dampproofing."
    2. Section 07 21 00 “Thermal Insulation” for insulation."
    3. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.

1.3 REFERENCE STANDARDS

A. AC59 Acceptance Criteria for Direct-Applied Exterior Finish Systems.
B. AC148 Acceptance Criteria for Flashing Materials.
C. ASTM C150 Standard Specification for Portanland Cement
D. ASTM C297 - Standard Test Method for Flatwise Tensile Strength of Sandwhich Constructions
E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.
H. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2025.
I. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2025.
J. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2025.
K. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2025.
L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
M. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2025.
N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
O. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
P. 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; 2026.
Q. 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).
R. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
S. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2025.
T. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2025.
U. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.

V. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

B. Sequencing

1. Coordinate installation of sheathing board and accessory materials, flashing, foundation waterproofing, roofing membrane, windows, doors, and other penetrations of the exterior walls to provide a continuous air and water-resistive membrane barrier.
2. Provide protection of rough openings before installing windows, doors, and other penetrations of the exterior walls.
3. Install window and door head flashings immediately after windows and doors are installed.Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
4. Install copings and sealants immediately after installation of the Exterior Insulation and Finish System with Moisture Drainage and when EIFS coatings are dry.
5. Attach penetrations through Exterior Insulation and Finish System to structural support and provide water-tight seals at penetrations.
6. Coordinate with framing / sheathing trades for stud framing locations in relationship to mineral wool insulation layout and mechanical fastener locations. Vertical edge of mineral wool insulation boards shall not extend greater than 8” maximum from center line of mechanical fastener.

1.5 SUBMITTALS

A. See Section Section 01 33 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

C. Submit two (2) samples of the Exterior Insulation and Finish System with Moisture Drainage for each finish, texture, and color to be used on the project. Use the same tools and techniques proposed for the actual installation. Make the samples of sufficient size to accurately represent each color and texture being utilized on the project.

D. Submit a current copy of the manufacturer’s Trained Contractor Certificate for the EIF system specified.

E. Submit a copy of the manufacturer’s installation details and application instructions.

1.6 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

B. EIFS Manufacturer Qualifications: Provide EIFS products from the same manufacturer with qualifications as follows:

1. Member in good standing of EIMA (EIFS Industry Members Association).
2. Manufacturer of EIFS products for not less than 5 years.
3. Manufacturing facilities ISO 9001 certified.

C. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.7 MOCK-UP

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.

C. Construct mock-up of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.

1. Prepared with the same products, tools, equipment and techniques required for the actual applications. Use finish from the same batch that is being used on the project.

D. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to the job site in the original, unopened packages with labels intact.
B. Inspect all components and materials upon arrival for physical damage, freezing or overheating. Do not use questionable materials.
C. Store all components and materials at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Maintain minimum and maximum storage temperature as stated in the product data sheets or specifications for the materials selected. Protect all products from inclement weather and direct sunlight.

1.9 FIELD CONDITIONS

A. Do not apply wet materials during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
B. Verify the minimum air and wall surface temperatures 24 hours before and at the time of application as stated in the product data sheets or specifications for the materials selected.
C. Maintain these temperatures with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for specific Specialty Finishes) thereafter, or until the products are completely dry.

1.10 WARRANTY

A. Manufacturer shall offer a limited material defect and labor to repair or replace defective material warranty stating the Products will be free from manufacturing defect and will perform as warranted in the manner specified for the stated term measured from the Date of Project Substantial Completion.
    1. A pre-construction meeting, including representatives of the Manufacturer, the Applicator, the Owner, and the Consultant (if applicable), shall be required prior to installation of the Products.
    2. The term of this warranty may be extended for an additional 2 years with involvement on the project of a Manufacturer-approved, third-party consultant (“Consultant”) engaged by the Owner or its authorized representative, at the Owner’s sole expense. Inspection reports generated by the Consultant shall be made available to the Manufacturer and the Owner.
    3. The warranty is available upon written request.
B. The warranty shall additionally include the following for the term of the warranty or as specifically noted hereunder.
    1. The warranty term shall be 20-years.
    2. The system will remain in a watertight condition when used in conjunction with approved Company Joinery and Sealants.
    3. Finish will be UV fade resistant for 10 years, except for specially produced colors.
        a. Specially produced colors will be UV fade resistant for 5 years when high-performance colorants are used to formulate.
    4. Installer Warranty
    5. Installer shall provide a separate minimum 1-year warranty for all workmanship related to the proper installation and drainage performance of the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Provide **Direct Applied Architectural Finish System** as manufactured by **Dryvt System, Inc.**, or a comparable product approved by the Architect.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        a. STO Corp.
B. Alternate direct-applied finish system manufacturers must demonstrate equivalency for all elements of a direct-applied finish system such as but not limited to:

1. Material components, compatibility and testing
2. Standard and specialty finishes
3. Color and texture matching
4. Warranty

C. Submit alternate manufacturer's complete data highlighting equivalency for review through Substitution Requirements as defined in Division 1.

2.2 DIRECT APPLIED COATING

A. System Description
   1. Direct Applied Architectural FInish System applied over Zip System sheathing only (no Zip tape is to be installed). The substrate is not apart of the system.

B. Materials
   1. Water-Resistive Barrier
      a. Dryvit Backstop NTX: A vapor permeable, flexible, polymer-based noncementitious water-resistive and air barrier coating available in Texture, Smooth, and Spray.
      b. Dryvit Grid Tape™: A 4 in (102 mm) wide, open weave fiberglass mesh tape used to reinforce sheathing joints and exposed edges of sheathing.
   2. Dryvit MD Spacer™: A polyethylene spacer, which separates the exterior cement board from the sheathing substrate. If other spacers are used, they are not part of the Dryvit finish system.
   3. Dryvit Base Coat
      a. Cementitious: A liquid polymer based material, which is field mixed in a 1:1 ratio by weight with Portland Cement.
         1) Shall be Genesis®.
      b. Ready mixed: A dry blend cementitious, polymer-based product, field mixed with water.
         1) Shall be Genesis® DM.
      c. Sprayable: A dry blend cementitious, polymer-modified product, field mixed with water and specifically formulated for spray applications to provide longer pot life, less false set, extended open time and stronger wet grip.
         1) Shall be Genesis® DMS.
   4. Reinforcing Mesh(es): Shall be a balanced open weave, glass fiber fabric treated for compatibility with other system materials.
      a. Dryvit Detail Mesh®: 4.3 oz/yd^2 (146 g/m^2), 9 1/2 in (241 mm) wide. Required at all exterior cement board joints and inside and outside corners.
      b. Dryvit Standard Mesh: 4.3 oz/yd^2 (146 g/m^2). Shall be installed over the entire exterior cement board face.
   5. Dryvit Finish: Shall be the type, color and texture as selected by the owner/architect and shall be the following:
      a. DPR (Dirt Pickup Resistance): Water based, acrylic coatings with integral color and texture and formulated with DPR chemistry:
         1) Type 1: Sandpebble Fina
         2) Type 2: Lymestone Fine

2.3 ACCESSORIES

A. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with exterior finish system manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard cell class for use intended, and ASTM C 1063.
   1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
   2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.

3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg extended to form a drip and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
4. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.
5. Soffit Vent: Aluminum extruded alloy 6063 T5, Powder caoted to match soffit color.
    a. Provide SV-50-V-300/EIF by Fry Regelt or comparable manufacturer.
    b. Size: 3 inch wide.

PART 3 EXECUTION

3.1 EXAMINATION

A. Ensure that site, material, and environmental conditions comply with relevant provisions of ASTM C 1397 “Standard Practice for Application of Class PB Exterior Insulation and Finish Systems”.
B. Verify access to electric power, clean water and a clean work area at the location where the Dryvit materials are to be applied.
C. Verify the designed deflection limit of the wall assembly / substrate system does not exceed 1/240 times the span.
D. Verify substrate is flat within 1/4 inch in a 4 feet radius.
E. Verify substrate is sound, dry, connections are tight; has no surface voids, projections, or other conditions that may interfere with system installation or performance.
F. Verify the slope of inclined surfaces are not less than 6:12 (27 o) where the length of the slope does not exceed 12 inch or 3:12 (14 o) where the length of the slope does not exceed 4 inch.
G. Verify metal roof flashings have been installed in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards.
H. Verify all rough openings are flashed in accordance with manufacturer’s installation details, or as otherwise necessary to prevent water penetration.
I. Verify windows and doors are installed and flashed per manufacturer's requirements and installation details.
J. Notify general contractor of all discrepancies prior to tinstallation.
K. Verify that expansion joints are to be installed:
    1. Where expansion joints occur in the substrate or underlying structural system.
    2. Where building expansion joints occur.
    3. At floor lines in wood frame construction.
    4. At floor lines of non-wood framed buildings where significant vertical movement is expected.
    5. Where the Exterior Insulation and Finish System with moisture drainage abuts dissimilar materials.
    6. Where the substrate type changes.
    7. Where prefabricated panels abut one another.
    8. In continuous elevations at intervals not exceeding 30 feet.
    9. Where significant structural movement occurs, such as changes in roof line, building shape or vertical and lateral translations of the underlying structural system.

3.2 PREPARATION

A. Protect adjoining work and property during installation.
B. Prepare the substrate to be free of foreign materials, such as oil, dust, dirt, form-release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

3.3 INSTALLATION

A. Install the EFS system in accordance with manufacturer's written instructions.

B. Apply base coat sufficient to fully embed the reinforcing mesh (Standard Plus (6oz/yd) or greater) and allow to dry. Apply a second base coat layer as required to provide a well prepared and level surface for application of selected texture finish coat.
C. Install high impact reinforcing mesh as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage as designated on contract drawings.
D. Apply sealant to base coat surface prepared in accordance with DS153.

3.4 SITE QUALITY CONTROL

A. EFS system manufacturer assumes no responsibility for on-site inspections or application of its products.
B. EFS system sub-contractor to certify in writing the quality of work performed relative to the substrate system, details, installation procedures, and as to the specific products used.
C. Mineral wool insulation supplier, if requested, to certify in writing that the mineral wool insulation complies with the mineral wool insulation and EFS system manufacturer's requirements.
D. The sealant contractor, if requested, certify in writing that the sealant material, accessories and application comply with the sealant and EFS system manufacturer's requirements.

3.5 CLEANING

A. Remove all excess EFS system materials from the job site by the contractor in accordance with contract provisions and as required by applicable law.
B. Leave all surrounding areas, where the EFS system has been applied, free of debris and foreign substances resulting from the EFS sub-contractor's work.

END OF SECTION 07 24 00

SECTION 07 42 13 - METAL WALL AND ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, exterior roof panels, subgirt framing, and snow guards , with related flashings and accessory components.

1.2 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.
B. Section 07 21 00 - Thermal Insulation.
C. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.3 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2025a.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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 wall panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.
E. Manufacturer's qualification statement.
F. Installer's qualification statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in installing products specified in this section with minimum five years of documented experience.

1.6 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.
C. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 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.

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 20-year 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

2.1 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners:

1. Berridge Manufacturing Company: www.berridge.com/#sle.
2. Centria, a Nucor Company: www.centria.com/#sle.
3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
4. McElroy Metal: www.mcelroymetal.com/#sle.
5. Petersen Aluminum Corporation: www.pac-clad.com/#sle.

2.2 METAL WALL & ROOF PANEL SYSTEM

A. Factory fabricated prefinished metal panel system, site assembled.

1. Provide exterior wall panels and exterior roof panels.
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 2-inch returns.

B. Exterior Wall Panels:

1. **Type 1**: Basis of Design: Provide "Pac-150 180^0 Seam" Standing Seam Metal Roof Panels as manufactured by Petersen Aluminum Corporation or equal with the following characteristics:
   a. Profile: Standing seam, with minimum 1-1/2-inch seam height; 180degree seam; concealed fastener system for field seaming with special tool.
   b. Width: Maximum panel coverage of 12 inches.
   c. Orientation: As indicated on drawings.
   d. Texture: Smooth.
   e. Material: Precoated steel sheet, 24 gauge, 0.0276 inch minimum thickness.
   f. Color: As selected by Architect from manufacturer's standard line.
2. **Type 3**: Basis of Design: Marquee Lok Metal Wall Panels as manufactured by McElroy Metals, Inc. or equal with the following characteristics:
   a. Profile: Flat pan; non-vented; concealed fastener system.
   b. Width: Maximum panel coverage of 12 inches.
   c. Orientation: Vertical
   d. Texture: Smooth.
   e. Material: Precoated steel sheet, 24 gauge, 0.0276 inch minimum thickness.

f. Color: As selected by Architect from manufacturer's standard line.

C. Exterior Roof Panels:
   1. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
   2. Basis of Design: Provide "Pac-150 180^0 Seam" Standing Seam Metal Roof Panels as manufactured by Petersen Aluminum Corporation or equal with the following characteristics:
      a. Profile: Standing seam, with minimum 1-1/2-inch seam height; 180degree seam; concealed fastener system for field seaming with special tool.
      b. Width: Maximum panel coverage of 12 inches.
      c. Orientation: As indicated on drawings.
      d. Material: Precoated steel sheet, 24 gauge, 0.0276 inch minimum thickness.
      e. Color: As selected by Architect from manufacturer's standard line.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed type, of profile to suit system.

F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

G. Anchors: Acceptable corrosion-resistant recommended by metal panel manufacturer..

2.3 MATERIALS

A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.4 FINISHES

A. Two coat coil applied, baked-on full-strength (70% resin, PVFD) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 - 0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness. The back side of the material should be 0.25 mil primer and a 0.25 mil polyester wash coat.

2.5 ACCESSORIES

A. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
   1. Basis of Design: Provide GreenGirt Max CMH, and CMH XO for windows and openings, by Advanced Architectural Products or equal with the following characteristics:
      a. Composite metal hybrid construction combining fiber-reinforced polymer with steel reinforced flanges with minimum thickness of 0.20 inches. Steel reinforcements to be G90 coated.
      b. Depth: As indicated on drawings.
      c. Length: 96 inches for girts and size as appropriate for openings.
      d. Spacing: 16 inches on center, vertically for girts.
      e. Fasteners: As recommended by clip manufacturer.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Snow Guards
   1. Continuous, Color-Matching - Type Snow retention system for standing seam metal roofs.
   2. Basis of Design: Provide ColorGard as manufactured by S-5! of Metal Roof Innovations, Ltd.
   3. Components:
      a. Clamps:
         1) Manufactured from 6000-series aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
            (a) S-5! Clamp model to be as recommended by the manufacturer for the specific seam profile used on the project.
            (b) Setscrews: 300-series stainless steel, 18-8 alloy, 3/8 inch (9.525 mm) diameter, with round nose point.

(c) Attachment bolts: 300-series stainless steel, 18-8 alloy, 8 mm diameter, hex flange bolt.

b. Brackets:
1) Manufactured from 6000-series alloy and temper-aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
(a) Bracket model to be as recomended by the manuacture for the specific seam profice.
2) Screws for attachment of brackets to roof: as specifically tested to the substrate used on the project, and furnished by snow guard manufacturer. All fastener portions exposed to the weather shall be stainless steel or Zinc/Aluminum cap.

c. Cross Members:
1) Manufactured from 6000-series alloy and temper-aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
2) Receptacle in face to receive color-matched metal strips.
3) Provide splice connectors ensuring alignment and structural continuity at end joints.

d. Color Strips: Same material and finish as roof panels; obtained from roof panel manufacturer.

e. Snow and Ice Clips:
1) Aluminum, with rubber foot extending to and resting at surface of metal panels; minimum 3 inches (76.2 mm) wide.
(a) Model: SnoClip III or SnapClip III for standing seam heights 1.75 inches (44.45 mm) to 3.25 inches (82.55 mm).

C. **Self-Adhering, High-Temperature Waterproof Membrane:** Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Basis-of-Design Product: Subject to compliance with requirements, provide **CCW WIP 300 HT** Product; a brand of **Carlisle Coating and Waterproofings** or comparable product by one of the following:
a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
b. Henry Company; a Carlisle company.
c. W.R. Grace.
d. SDP Advanced Polymer Products Inc.

D. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts. Provide per roof manufacture’s recommendation.

E. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

F. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building framing members are ready to receive panels.

3.2 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.3 INSTALLATION

A. Support for Cladding and Continuous Insulation: Install in accordance with manufacturer's written instructions; securely fasten; shim and level to uniform plane.

B. Install panels on walls and roof in accordance with manufacturer's instructions.
C. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow to dry prior to wall panel installation.
D. **Installation of Underlayment (Roof): Self-Adhering Sheet Waterproof Membrane: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below and on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.**
    1. Apply over the entire roof surface.
    2. Apply second layer over the roof area indicated below:
        a. Roof perimeter for a distance up from eaves of 24 inches beyond interior wall line.
        b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches . Overlap ends of sheets not less than 6 inches.
        c. Rake edges for a distance of 18 inches .
        d. Hips and ridges for a distance on each side of 12 inches .
        e. Roof-to-wall intersections for a distance from wall of 18 inches .
        f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches .
E. Felt Underlayment (Roof and Wall): Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.
    1. Apply over the entire roof surface.
F. Slip Sheet (Roof and Wall): Apply slip sheet over underlayment before installing metal roof panels.
G. Fasten panels to structural supports; aligned, level, and plumb.
H. Provide expansion and control joints where indicated on drawings.
I. Use concealed fasteners unless otherwise indicated by Architect.
J. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.
K. Snow Guards: Install system in accordance with manufacturer's instructions and approved shop drawings.

3.4 CLEANING

A. See Section 01 70 00 - 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.

3.5 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 07 42 13

This page intentionally left blank

SECTION 07 42 13.19 - INSULATED METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Factory-assembled metal panel system for walls, with trim, related flashings and accessory components.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation.
B. Section 07 42 13 - Metal Wall Panels

1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
B. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).
C. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
D. 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).
E. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2022.

1.4 PREINSTALLATION MEETING

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide manufacturer documentation on tested structural and thermal capabilities of assembled panel.
C. Shop Drawings: Indicate dimensions, panel profile and layout, joints, and construction details.
D. Samples: Submit one samples of panel, 12x12 inch in size illustrating finish color, sheen, and texture.
E. Design and Performance Data: Indicate panel profile and dimensions.
F. Manufacturer's qualification statement.
G. Installer's qualification statement.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
B. Installer Qualifications: Company specializing in performing work of this Section with minimum five years experience.

1.7 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.
C. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
    1. Build mockup of typical wall area as shown on Drawings.
    2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
    3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
B. Store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 20-year 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

2.1 MANUFACTURERS

A. Insulated Metal Wall Panels:
   1. Centria, a Nucor Company: www.centria.com/#sle.
   2. Kingspan Insulated Panels: www.kingspan.com/#sle.
   3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PERFORMANCE / DESIGN CRITERIA

A. Metal Panel System: Factory-assembled metal panel system, with trim, related flashings and accessory components.
   1. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   2. Accommodate tolerances of building structural framing.

B. Performance Requirements:
   1. Thermal Performance: Provide thermal resistance through entire system; R-value of 16.7, minimum.
   2. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
      a. Test Pressure Difference: 1.57 lbf/sq. ft. (75 Pa)
   3. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
      a. Test Pressure Difference: 6.24 lbf/sq. ft. (300 Pa)
   4. Structural Performance: Design and size to withstand all dead loads and wind loads caused by positive and negative wind pressure acting normal to plane of panel.
      a. Verify structural performance in accordance with ASTM E330/E330M, using test pressure 1.5 times design wind pressure, with 10 seconds duration of maximum load.
      b. Design Wind Loads: As indicated on drawings.
      c. Maximum Allowable Deflection of Panel: 1/180 deflection of panel perimeter normal to plane of wall with no evidence of failure.
      d. Seismic Performance: Allow for panel movement under seismic loads without damage or failure of the panel system.
   5. Fire Resistance: Class 1 fire rated, without height limitation, when tested in accordance with FM 4880.
   6. Movement: Accommodate the movement caused by the following without damage to system, components, or deterioration of seals:
      a. Normal movement between system components.
      b. Seasonal temperature cycling.
      c. Deflection of structural support framing,

2.3 FOAMED-INSULATION-CORE METAL WALL PANELS

A. Wall Panels: Exterior and interior metal sheet skin, factory-assembled, with foamed-in-place insulation; exterior and interior sheet interlocking at edges, filled with sealant, attached to supports with concealed fasteners.

B. Type 2: Provide Versawall V+ insulated metal wall panels as manufactured by Centria or equal with the following characteristics:

1. Panel Width: 30 inch.
2. Profile: Embossed, Flat; vertical panels.
3. Panel Thickness: 2 inch.
4. Exterior Sheet: Pre-finished galvanized steel, 24 gauge, 0.0250 inch minimum base metal thickness .
5. Interior Sheet: Galvanized steel, pre-finished, 24 gauge, 0.0250 inch minimum base metal thickness.
6. Panel Edge Profile: Tongue and groove, for flush seam.
7. Fabricate panels in longest practicable lengths.
8. Exterior Finish: Fluoropolymer Three-Coat System: 0.8 mil primer with 0.8 mil 70 percent fluoropolymer color coat, and a 0.8 mil 70 percent PVDF fluoropolymer clear coat. coating; color as selected from manufacturer's standard range.

2.4 MATERIALS

A. Precoated Galvanized Steel Sheet: ASTM A653/A653M, Commercial Steel (CS) or Forming Steel (FS), with G90/Z275 coating; continuous-coil-coated with acrylic primer coat and polyester washcoat for panel back.

B. Foamed-in-Place Insulation: Polyisocyanurate non-CFC blowing agent type.

1. Compressive Strength: >20 psi, in accordance with ASTM D1621 test method.
2. Density: >20 lb/cu ft, in accordance with ASTM D1622 test method.

C. Panel Sealants: Manufacturer's standard type suitable for use with installation of panel system; non-staining, skinning, non-shrinking, non-sagging, ultra-violet and ozone resistant; color as selected by Architect.

2.5 ACCESSORIES

A. General: Provide complete metal wall panel assembly incorporating trim, copings, facia, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, closure strips, and caps for a complete installation. Fabricate and install accessories in accordance with SMACNA Manual.

B. Fasteners: Manufacturer's standard type to suit application; self-tapping.Where exposed fasteners cannot be avoided, provide corrosion-resistent fasteners with fastener cap same color as exterior panel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that structural framing is ready to receive panel system.

3.2 PREPARATION

A. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.3 INSTALLATION

A. Install panel system on walls in accordance with manufacturer's instructions.

B. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.

C. Locate panel joints over supports.

D. Provide expansion joints where indicated.

E. Use concealed fasteners unless otherwise approved by Architect.

F. Provide sealant/sealant tape at lapped joints and between panels and protruding equipment, vents, and accessories.
G. Apply continuous ribbon of sealant/selant tape to panel side laps and elsewhere as needed to make panels weathertight.

3.4 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.5 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
B. Remove site cuttings from finish surfaces.
C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.6 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 07 42 13.19

SECTION 07 54 00 - THERMOPLASTIC MEMBRANE (TPO) ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Cover boards.
D. Roofing cant strips, stack boots, and walkway pads.

1.2 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking: Placement of acoustical insulation for deck flutes.
B. Section 06 10 00 - Rough Carpentry: Wood cant strips.
C. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof flashing and counterflashing.
D. Section 07 72 00 - Roof Accessories: Roof accessories.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA (RM)'s "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
B. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2020.
C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.
D. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2025.
E. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.
F. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2025.
G. CRRC-1 - CRRC-1 Roof Product Rating Program Manual; 2024.
H. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction; 2022.
I. NRCA (RM) - The NRCA Roofing Manual; 2026.
J. NRCA (WM) - The NRCA Waterproofing Manual; 2021.
K. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.
C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.
D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.
E. Manufacturer's Certificate:
    1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
        a. Submit evidence of compliance with performance requirements.
    2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
F. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

G. Evaluation Reports: For components of roofing system, from ICC-ES.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.
J. Warranty Documentation:
    1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
    2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of this section with at least five years of documented experience and approved by manufacturer.
    1. Is eligible to receive manufacturer's special warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
B. Store materials in weather protected environment, clear of ground and moisture.
    1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
D. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
E. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F, not to exceed manufacturer recommendations.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
    1. Warranty Period: **30 years** from date of substantial completion.
    2. Special warranty includes roof membrane, base flashings, and other components of roofing system.
    3. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
    1. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.
    2. Elevate: www.holcimelevate.com/#sle.
    3. GAF: www.gaf.com/#sle.

4. GenFlex Roofing Systems, LLC: www.genflex.com/#sle.
5. Johns Manville: www.jm.com/#sle.

B. Insulation:
1. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.
2. GAF: www.gaf.com/#sle.
3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
4. Versico Roofing Systems: www.versico.com/#sle.
5. Johns Manville; A Berkshire Hathaway Company

C. Cover Boards:
1. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.
2. GAF: www.gaf.com/#sle.
3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
4. Versico Roofing Systems: www.versico.com/#sle.
5. Johns Manville; A Berkshire Hathaway Company

2.2 ROOFING - UNBALLASTED APPLICATIONS

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation and insulated cover baard.

B. Roofing Assembly Requirements:
1. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
a. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G154, or ASTM G155.
b. Puncture Resistance: Roof membrane shall resist puncture damage when tested according to FTM 101C, method 2031.
c. *Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272 [AD01].*
2. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
a. *Hail-Resistance Rating: SH [AD01].*
3. Wind Uplift Resistence: Design and install roofing system as a complete assembly capable of resisting wind uplift pressures calculated in accordance with [2021] IBC and ASCE 7-[22], *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, Chapter 30, Components and Cladding, for the building's risk category, exposure category, and geographic location. Provide a UL Classified assembly, tested in accordance with UL 580 and UL 1897, with a minimum wind uplift classification of UL Class 90 for all roof zones.
a. Where design wind uplift pressures calculated per ASCE 7 exceed 90 psf in perimeter or corner zones, provide supplemental engineering documentation demonstrating that the proposed assembly meets or exceeds the calculated zone pressures.
4. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
5. R-Value: Min. R-30 at lowest point (roof drains).
6. Energy Performance: Roofing system shall have a 3-year aged Solar Reflectance Index (SRI) of not less than 0.64 when tested according to CRRC-1.
7. Exterior Fire-Test Exposure: ASTM E108 or UL 790, **Class C**; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Acceptable Insulation Types - Tapered Application: Any of types specified.
1. Tapered polyisocyanurate board.

2.3 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
      a. Thickness: 80 mil, 0.080 inch, minimum.
   2. Sheet Width: Factory fabricated into widest possible sheets.
   3. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

2.4 COVER BOARDS

A. Cover Boards: Faced, and with high compressive strength polyisocyanurate (ISO) insulation complying with ASTM C1289, and the following characteristics:
   1. Classifications:
      a. Type II - Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 4 - faced with coated or uncoated glass-fiber-mat facers on both major surfaces of core foam
         2) Compressive Strength: Grade 1, 80 psi.
      b. Thickness: 1/2 inch.
   2. Board Size: 48 by 48 inches.
   3. Board Thickness: 1/2 inch, maximum.
   4. Insulation Thermal Resistance, R-value: 2.5, nominal.

2.5 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289, mechanically fastened to deck.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 2, 20 psi (138 kPa), minimum.
         3) Thermal Resistance, Derated (LTTR) R-value: At 2 layers thick; 11.0, minimum, at 75 degrees F. Maintain a min. of R-30 at all locations.
   2. Board Size: 48 by 96 inches.
   3. Board Thickness: As indicated in drawings. Installed in a min. of 2 layers, stagger panel joints minimum 6 inches in each direction.
   4. Tapered Board: Slope as indicated; minimum thickness 1/4 inch; fabricate of fewest layers possible.
      a. Slope:
         1) Roof Field: **1/4 inch per foot (1:48)** unless otherwise indicated on Drawings.
         2) Saddles and Crickets: **1/2 inch per foot (1:24)** unless otherwise indicated on Drawings.

2.6 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Cant and Edge Strips: Backer rod, compatible with roofing materials; other configurations as detailed.

C. Membrane Adhesive: As recommended by membrane manufacturer.
   1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
   2. Adhesives and sealants shall comply with the following limits for VOC content:
      a. Plastic Foam Adhesives: 50 g/L.

b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Non-membrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing over ballast.

F. **Walkway Pads:** Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
1. Composition: Roofing membrane manufacturer's standard or product compatible with roof system.
2. Size: As indicated on drawings, but no less than 30" width.
3. Surface Color: Gray.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

PART 3 EXECUTION

3.1 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 as required in Section 50 31 00 - Steel Decking.
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.

3.2 PREPARATION - METAL DECK

3.3 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
B. Do not apply roofing membrane during cold or wet weather conditions.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.4 INSTALLATION - COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.
    a. Trim cover board so that water flow is unrestricted.
3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Loosely lay cover board over substrate.
5. Adhere cover board to substrate using adhesive.

3.5 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
    1. Allow to relax before installing.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Apply adhesive to substrate at rate as required by manufacturer's written instructions. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
D. Overlap edges and ends and seal seams by heat welding, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
    1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
    2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
    3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements
E. At intersections with vertical surfaces:
    1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
    2. Fully adhere flexible flashing over membrane and up to nailing strips.
F. Around roof penetrations, seal flanges and flashings with flexible flashing.
G. Coordinate installation of roof drains, sumps, and gutters and related flashings.

3.6 INSTALLATION - INSULATION

A. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
B. Fully adherer subsequent layers.
C. Place insulation boards; butt in close contact. Place channel cut face down. Bevel insulation to allow snug fit at cant strips. Cut neatly around protrusions through roof.
D. Install insulation in minimum 2 layers. Stagger joints min. 6 inches in both directions.
E. Install and fit perimeter restraint to minimize movement of insulation boards.

3.7 INSTALLATION - WALKWAYS

A. Install flexible walkways at the following locations:
    1. **As indicated on Drawings**.
B. Provide 6-inch (76-mm) clearance between adjoining pads.
C. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. 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.
C. Repair or replace defaced or damaged finishes caused by work of this section.

3.10 PROTECTION

A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.
C. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION 07 54 00

This page intentionally left blank

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formed low-slope roof sheet metal fabrications.
B. Formed wall sheet metal fabrications.
C. Formed equipment support flashing.
D. Formed sheet metal items, including flashings, counterflashings, gutters, exterior penetrations, and other items indicated in Schedule.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: for wood nailers, curbs, and blocking.
B. Section 07 72 00 - Roof Accessories: for set-on-type curbs, equipment supports, and other manufactured roof accessory units.
C. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing: for sheet metal flashing and trim integral with TPO roofing.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2026.
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 A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2025a.
D. ASTM B32 - Standard Specification for Solder Metal; 2020.
E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
G. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
H. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement; 2025.
J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.
C. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
    1. Include plans, elevations, sections, and attachment details.

2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

D. Samples: Submit two samples, 12 inches long by actual width, illustrating metal finish for each color.

1.6 MOCK-UPS

A. See Section 01 40 00-Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Maintain one copy of each document on site.
C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
C. Prevent contact with materials that could cause discoloration or staining.

1.9 WARRANTY

A. See Section 01 78 00-Closeout Submittals for additional warranty requirements.
B. Finish Warranty: Provide 20-year 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.
    1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
        a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
        b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
        c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
   1. Design Pressure: **As indicated on Drawings.**
D. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 120 degrees F; 180 degrees F, material surfaces.

2.2 SHEET MATERIALS

A. Pre-Finished Aluminum-Zinc Alloy Coated Steel: ASTM A792/A792M with AZ50 zinc coating; shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's custom and full range of colors.
   3. Surface: Smooth, flat.
B. Anodized Aluminum: ASTM B209/B209M, 3003 alloy, H14 temper; anodized finish of adjacent color as indicated on drawings.
   1. Clear Anodized Finish: AAMA 611, AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch thick.
C. Terne Coated Stainless Steel: 28-gauge, 0.0156-inch ASTM A666/A666M Type 304 alloy core material with 0.092 lb/sq ft terne alloy coating on both sides of core metal.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM, PVC, or TPO sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
   3. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F 2329.
C. Solder:
   1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187/D1187M.
I. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.4 FABRICATION

A. General: Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
   1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
   2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
   4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
   1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Form sections true to shape, accurate in size, square, and free from distortion or defects.

E. Form pieces in longest possible lengths.

F. Hem exposed edges on underside 1/2 inch; miter and seam corners.

G. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

H. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

I. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

J. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

K. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

L. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength in locations not exposed to view.

M. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength in locations not exposed to view.

N. Do not use graphite pencils to mark metal surfaces.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch- wide, joint cover plates.
   1. Joint Style: Overlapped, 4 inches wide.
   2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
   3. Fabricate from the Following Materials:
      a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick - 24 GA.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: As indicated on drawings to follow the shape of the bulding.
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the Following Materials:
    a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.See Drawings for wall thickness, and provide gauge or thickness of flashing as recommended for brake metal flashing in SMACNA.

C. Base Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick - 24 GA.
2. Profiles: as indicated on drawings to follow the curve of the building.

D. Counterflashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick - 24 GA.

E. Flashing Receivers: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick - 24 GA.

F. Roof-Penetration Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick - 24 GA.

G. Roof-Drain Flashing: Fabricate from the following materials:
1. Terne-Coated Stainless Steel: 0.015 inch thick - 28 GA.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick - 24 GA.

B. Other Flashings and Trim pieces (including interior locations see drawings)
1. Unbroken face dimension of 6” or less: Fabricate from the following materials:
    a. Anodized Aluminum: 0.040 inch thick.
2. Unbroken face dimension of 6”-12”: Fabricate from the following materials:
    a. Anodized Aluminum: 0.080 inch thick.
3. Foundation Protection Cover: Fabricate from the following materials:
    a. Anodized Aluminum: 0.080 inch thick.
4. See Drawings for panels of larger dimensions. If gauge or thickness not directly stated, thickness shall be as recommended for brake metal flashing in SMACNA (ASMM).

2.7 GUTTERS AND DOWNSPOUTS

A. Fabricate Gutters and Scuppers In accordance with SMACNA (ASMM) requirements.

B. Gutters: Profile as indicated on drawings based on SMACNA Rectangular Style "A". Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.0.40 inch thick - 20 GA

C. Scuppers: Profile and dimensions as indicated on drawings.
1. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick - 20 GA

D. Accessories: Profiled to suit gutters and downspouts.
1. Anchorage Devices and Brackets: In accordance with SMACNA (ASMM) requirements.

E. Seal metal joints.

2.8 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.

2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

D. Underlayment: Polyethylene, 6 mil, 0.006 inch thick.
E. Slip Sheet: Rosin-sized sheathing paper, 3 lb/100 sq. ft. minimum.
F. Primer Type: Zinc chromate.
G. Concealed Sealants: Non-curing butyl sealant.
H. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
I. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.
C. Verify compliance with requirements for installation tolerances of substrates.
D. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
E. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.3 INSTALLATION

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
   5. Install sealant tape where indicated.
   6. Torch cutting of sheet metal flashing and trim is not permitted.
   7. Do not use graphite pencils to mark metal surfaces.
B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate
1. Wood blocking or sheathing: not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws. Substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
2. Metal decking: not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength and not exposed to view.

I. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.

J. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.

K. Secure gutters in place with concealed fasteners.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at [24-inch] [16-inch] centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at [24-inch] centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant; interlocking folded seam or blind rivets and sealant unless otherwise indicated.
F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder.
C. Clean off excess sealants.
D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.9 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for field inspection requirements.
B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION 07 62 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof penetrations mounting curbs.
B. Roof hatches.
C. Factory-fabricated ladder safety posts.
D. Preformed flashing sleeves.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
B. Section 07 54 00 - Thermoplastic Polyolefin (TPO) Roofing.
C. Section 07 62 00 - Sheet Metal Flashing and Trim: for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
D. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items.
E. Warranty Documentation:
    1. Submit manufacturer warranty.
    2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
B. Store products in manufacturer's unopened packaging until ready for installation.
C. Store products under cover and elevated above grade.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide 5-year manufacturer warranty guaranteeing products to be free from defects in material and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

B. Roof Hatch Manufacturers:
   1. Acudor Products Inc: www.acudor.com/#sle.
   2. Best Access Doors: www.bestaccessdoors.com/#sle.
   3. Bilco Company: www.bilco.com/#sle.

C. **Roof Hatch Type L**
   1. **Basis-of-Design Product**: Provide Type E-50TB Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.BILCO.com.
   2. Furnish and install where indicated on plans metal roof hatch size 36" x 36". Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
   3. Performance characteristics:
      a. Cover and curb shall be thermally broken to prevent heat transfer between interior and exterior surfaces and resist condensation.
      b. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
      c. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
      d. Operation of the cover shall not be affected by temperature.
      e. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
   4. Cover: Shall be 11 gauge aluminum with a 5” beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
   5. Cover insulation: Shall be 3” thick polyisocyanurate with an R-value = 20.3, fully covered and protected by an 18 gauge aluminum liner.
   6. Curb: Shall be 12” in height and of 11 gauge aluminum. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 5-1/2” flange with 7/16” holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6” on center, to be bent inward to hold single ply roofing membrane securely in place.
   7. Curb insulation: Shall be 3” thick polyisocyanurate with an R-value = 20.3.
   8. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
   9. Hardware
      a. Heavy stainless steel pintle hinges shall be provided
      b. Cover shall be equipped with an enclosed two-point spring latch with interior and exterior turn handles.
      c. Roof hatch shall be equipped with interior and exterior padlock hasps.
      d. The latch strike shall be a stamped component bolted to the curb assembly.
      e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1” diameter red vinyl grip handle to permit easy release for closing.

f. All hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].

g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

10. Finishes: Factory finish shall be mill finish aluminum.

2.2 LADDER SAFETY POST

A. **Basis-of-Design Manufacturer:** Type LU Ladder Safety Post by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.bilco.com. Comply with the following:

B. Furnish and install at roof hatch. Ladder safety post Model LU-1, The ladder safety post shall be pre-assembled from the manufacturer.

C. Performance characteristics:

1. Tubular post shall lock automatically when fully extended.
2. Safety post shall have controlled upward and downward movement.
3. Release lever shall disengage the post to allow it to be returned to its lowered position.
4. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14” (356mm) on center and clamp brackets to accommodate ladder rungs up to 1-3/4” (44mm) in diameter.

D. Post: Shall be manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.

E. Material of construction: Shall be steel.

F. Balancing spring: A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post.

G. Hardware: All mounting hardware shall be Type 316 stainless steel.

H. Finishes: Factory finish shall be yellow powder coat steel.

2.3 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and perforated metal collar.

1. Metal: Aluminum sheet, 0.063 inch thick.
2. Diameter: As indicated on Drawings.
3. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Metal: Aluminum sheet, 0.063 inch thick.
2. Height: 13 inches.
3. Diameter: As indicated on Drawings.
4. Finish: Manufacturer's standard.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum or stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Roof-Hatch Installation:
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach ladder-assist post according to manufacturer's written instructions.

F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

G. Preformed Flashing-Sleeve and Flashing-Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

H. Seal joints with sealant as required by roof accessory manufacturer.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION 07 72 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants.
C. Joint backings and accessories.
D. Joint sealant schedule.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: for masonry control and expansion joint fillers and gaskets.
B. Section 08 80 00 - Glazing.
C. Section 09 21 16 - Gypsum Board Assemblies: Sealing perimeter joints.
D. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.
E. Single source supplier must supply compatible products under all related sections below or provide compatibility testing for materials that connect to or come in contact with the product being provided:
    1. Section 07 14 00 "Fluid-Applied Waterproofing / Dampproofing."
    2. Section 07 21 00 “Thermal Insulation” for insulation."
    3. Section 07 24 00 "Exterior Insulation & Finish System (EIFS)" for the air barrier and detail membranes within this system.
    4. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.
    5. Section 08 44 13 “Glazed Aluminum Curtain Walls” for extruded silicone air and vapor barrier transitions.

1.3 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 C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.
C. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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.
    6. Substrates for which use of primer is required.
    7. Substrates for which laboratory adhesion and/or compatibility testing is required.

8. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
9. Sample product warranty.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Samples: For each kind and color of joint sealant required.
E. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.
F. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
G. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
H. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
I. Installation Plan: Submit at least four weeks prior to start of installation.
J. Installation Log: Submit filled-out log for each length or instance of sealant installed.
K. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
1. Adhesion Testing: In accordance with ASTM C794.
2. Compatibility Testing: In accordance with ASTM C1087.
3. Allow sufficient time for testing to avoid delaying the work.
4. Deliver sufficient samples to manufacturer for testing.
5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
C. Installation Plan: Include schedule of sealed joints, including the following:
1. Joint width indicated in Contract Documents.
2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
4. Installation Log Form: Include the following data fields, with known information filled out.
a. Date of installation.
b. Name of installer.
c. Actual joint width; provide space to indicate maximum and minimum width.
d. Actual joint depth to face of backing material at centerline of joint.
e. Air temperature.

1.6 MOCK-UPS

A. See Section 01 40 00-Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.

1.7 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.
2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.
   1. Warranty Period: **Five years** from date of Substantial Completion.
C. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: **Two years** from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:
   1. Adfast USA Inc: www.adfastcorp.com/#sle.
   2. Dow: www.dow.com/#sle.
   3. Henry Company: www.henry.com/#sle.
   4. Sika Corporation: www.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 01 60 00 - Product Requirements.
B. Self-Leveling Sealants:
   1. Dow: www.dow.com/#sle.
   2. Sika Corporation: www.usa.sika.com/#sle.
   3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   4. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.
C. Pre-compressed, self-expanding foam joint sealant:
   1. Basis-of-Design: Provide Willseal 600 manufactured by Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal the following joints:
         1) Wall expansion and control joints.
         2) Joints between doors, windows, and other frames or adjacent construction.
         3) Joints between different exposed materials.
         4) Other joints as indicated on Drawings.
   2. Interior Joints:
      a. Seal the following joints:
         1) Joints between door frames and window frames and adjacent construction.
         2) In wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
         3) In wall and ceiling assemblies, seal joints between wall assemblies and ceiling assemblies; between wall assemblies and other construction; between ceiling assemblies and other construction.

4) In wet areas around plumbing fixtures and countertops and other similar items.
5) Other joints as indicated on Drawings.

3. Do Not Seal:
   a. Intentional weep holes in masonry.

2.3 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
   1. Architectural sealants shall have a VOC content of **250 g/L** or less.
   2. Sealants and sealant primers for nonporous substrates shall have a VOC content of **250 g/L** or less.
   3. Sealants and sealant primers for nonporous substrates shall have a VOC content of **775 g/L** or less.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.4 NONSAG JOINT SEALANTS

A. Type JS-1 - Joint Sealant Application: Exterior joints in vertical and horizontal non-traffic surfaces, nonstaining.
   1. Joint Locations:
      a. Joints between metal panels.
      b. Joints between different materials listed above.
      c. Perimeter joints between materials listed above and frames of doors, windows and louvers.
      d. Other joints as indicated on Drawings.
   2. Joint Sealant: Silicone, Type S, Grade NS, Class 50, Uses NT, G, and A ("aluminum").
   3. Movement Capability: Plus and minus 50 percent, minimum.
   4. Color: To be selected by Architect from manufacturer's full range.

B. Type JS-2 - Joint Sealant Application: Exterior joints in vertical and horizontal non-traffic surfaces, nonstaining.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints in exterior insulation and finish systems.
   2. Joint Sealant: Silyl-Modified Polymer (SMP), Type S or M, Grade NS, Class 35, Uses NT and M
   3. Movement Capability: Plus and minus 35 percent, minimum.
   4. Color: To be selected by Architect from manufacturer's full range.

C. Type JS-3 - Joint Sealant Application: Joints in vertical and horizontal surfaces subject to water immersion.
   1. Joint Locations:
      a. Joints below grade.
      b. Penetrations through below grade structure.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Polyurethane, ASTM C920, Type S or M, Grade NS, explicitly approved by manufacturer for continuous water immersion.
      a. Manufacturer's written statement of compatibility with waterproofing and dampproofing materials.
   3. Movement Capability: Plus and minus 35 percent, minimum.
   4. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
   5. Color: Match adjacent finished surfaces.
   6. Service Temperature Range: Minus 40 to 180 degrees F.

2.5 SELF-LEVELING JOINT SEALANTS

A. Type JS-4 - Joint Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
    a. Joints in cast-in-place concrete slabs.
    b. Joints between different materials listed above.
    c. Other joints as indicated on Drawings.
2. Joint Sealant: Polyurethane, Type S or M, Grade P, Uses T, M, and O.
3. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
4. Color: To be selected by Architect from manufacturer's custom range.

2.6 ACCESSORIES

A. Sealant Backing Materials, General: Nonstaining; 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.
B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
D. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
E. Joint Cleaner: Noncorrosive and nonstaining, type recommended by sealant manufacturer; compatible with joint forming materials.
F. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.1 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.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.
    1. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
        a. Concrete.
        b. Masonry.
        c. Exterior insulation and finish systems.
    2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
        a. Metal.
        b. Glass.
C. Remove laitance and form-release agents from concrete.
D. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

1. BJoint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.
2. Masking Tape: 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.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.3 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.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. 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.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
   4. Provide flush joint profile according to Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth according to Figure 8C in ASTM C 1193.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

This page intentionally left blank

SECTION 081113 – HEAVY DUTY HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior heavy duty steel doors and frames.
2. Exterior heavy duty steel doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

1.3 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped , or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4 inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4 inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

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

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Republic Doors and Frames.
4. Steelcraft; an Allegion brand.

2.2 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4,

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Gauge: 16 gauge

d. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 A60 coating.
e. Edge Construction: Model 1, Full Flush.

f. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches Provide manufacturer's standard beveled or square edges.
g. Bottom Edges: Close bottom edges of doors[where required for attachment of weather stripping] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.

2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

F. Glazing (If needed-refer to door elevations in drawings): Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior insulated coiling doors.
B. Interior non-fire-rated coiling doors.
C. Springless upward coiling grilles.
D. Electric operators and control stations.
E. Wiring from electric circuit disconnect to operators and control stations.

1.2 RELATED REQUIREMENTS

A. Section 26 05 83 - Wiring Connections: Power to disconnect.

1.3 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; Current Edition.
B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
D. NEMA MG 00001 - Motors and Generators; 2024.
E. UL (DIR) - Online Certifications Directory; Current Edition.
F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide general construction, electrical equipment, and component connections and details.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
D. Samples: Two slats, 2 by 6” inches in size illustrating shape, color and finish texture.
E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
F. Installer's qualification statement.
G. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.
C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified and indicated.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide 2-year manufacturer warranty for roller shaft counterbalance assembly. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Basis of Design Manufacturer**: Overhead Door Corporation. Available manufacturers offering products that may be incorporated into the Work include the following:
   1. C.H.I. Overhead Doors; Model 6180: www.chiohd.com/#sle.
   2. Clopay: www.clopaydoor.com/#sle.

3. Raynor Garage Doors; DuraCoil, Model ___: www.raynor.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 COILING DOORS

A. Exterior Coiling Doors Type Insulated: Steel slat curtain.
   1. Basis of Design: Provide Stormtite Advanced Performance Model 627 as manufactured by Overhead Door Corporation, or products of equivalent performance characteristics if approved substitution.
   2. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.
   3. Bottom weatherseal, interior and exterior EPDM triple-finned guide brush weatherseals, interior hood baffle and lintel seal
   4. Provide thermally broken threshhold, equal to Pemko 252 x 3SSFG Stainless Steel Thermal Barrier.
   5. Slats: 24 gauge galvanized steel front and back interlocking sandwhich slats with core of foamed-in-place polyurethane insulation; minimum R-value of 10.9.
      a. Profile: Flat
      b. Nominal Slat Size: 1 3/8 inches thick by required length.
      c. Finish: Primed, painted. Color: As selected from manufacturer's standard range..
   6. Guides: Galvanized steel angles, with mounting brackets of same material, of profile to retain grille in place. Ultra-high molecular weight polyethylene wear strips and premium powder coat finish in black.
   7. Bottom Bar: Black powder coated steel with vinyl weatherseal.
   8. Hood Enclosure and Trim: 24 gauge galvanized steel, primed, completely covering operating mechanisms; internally reinforced to maintain rigidity and shape. Primed and painted to match door.
   9. Electric operation.
   10. Mounting: As indicated on drawings.
   11. Life Cycle: Min. 100,000 higher life cycle spring package.
B. Interior Non-Fire-Rated Coiling Doors: Aluminum slat curtain.
   1. Basis of Design: Provide EverServe Aluminum Glass Door Model 521s as manufactured by Overhead Door Corporation, or products of equivalent performance characteristics if approved substitution.
   2. Panels: Aluminum construction and reinforcement.
   3. Panel Thickness: 1 3/4 inches.
   4. Panel Finish: Clear anodized.
   5. Sectional Height: 2' 0"
   6. Glazing: Impact Clear Polycarbonate
   7. Manual hand chain lift operation.
   8. Life Cycle: Min. 300,000 cycles.
   9. Mounting: Surface mounted.
   10. Guides: Galvanized steel angles, with mounting brackets of same material, of profile to retain grille in place. Ultra-high molecular weight polyethylene wear strips and premium powder coat finish in black.
   11. Hood Enclosure and Trim: 24 gauge galvanized steel, primed, completely covering operating mechanisms; internally reinforced to maintain rigidity and shape.
   12. Locking Devices: None.
C. Upward Coiling Grilles
   1. Basis of Design: Provide EverServe Springless Security Grille 671s as manufactured by Overhead Door Corporation, or products of equivalent performance characteristics if approved substitution.
   2. Grille: Galvanized steel; horizontal bar curtain, coiling on overhead counterbalanced shaft.
      a. Electric operation.
      b. Mounting: As indicated on drawings.

3. Curtain: Round horizontal bars connected with vertical links.
    a. Bar spacing: 2 inch on center.
    b. Link spacing: 9 inch on center.
    c. Bottom Bar: Tubular extruded aluminum with mill finish..
    d. Pattern: Staggered brick.
4. Guides: Galvanized steel angles, with mounting brackets of same material, of profile to retain grille in place. Ultra-high molecular weight polyethylene wear strips and premium powder coat finish in black.
5. Hood Enclosure and Trim: 24 gauge galvanized steel, primed, completely covering operating mechanisms; internally reinforced to maintain rigidity and shape.
6. LIfe Cycle: Min. 300,000 cycles.

2.3 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
    1. Provide interlock switches on motor operated units.
B. Electric Operators:
    1. Basis of Design: Provide Model RSX Standard Duty Operator as manufactured by Overhead Door Company or products of equvalent performance characteristics if approved substitution.
    2. Mounting: Side mounted.
    3. Motor Enclosure:
        a. Interior Coiling Doors: NEMA MG 00001, Type 1; open drip proof.
    4. Motor Rating: 1/2 HP; continuous duty.
    5. Motor Voltage: 460 volts, three phase, 60 Hz.
    6. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
    7. Controller Enclosure: NEMA EN 10250, Type 4.
    8. Opening Speed: 12 inches per second.
    9. Brake: Adjustable friction clutch type, activated by motor controller.
    10. Manual override in case of power failure.
    11. See Section 26 05 83 for electrical connections.
C. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with UL 325.
    1. 24 volt circuit.
    2. Surface mounted, at interior door jamb.
    3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325full width of door opening.
        a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
D. Safety Edge: Located at bottom of coiling door, full width of door, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.
B. Verify that electrical services have been installed and are accessible.
C. Verify that door opening is plumb, header is level, and dimensions are correct.
D. Notify Architect of any unacceptable conditions or varying dimensions.
E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
E. Coordinate installation of electrical service with Section 26 05 83.
F. Complete wiring from disconnect to unit components.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch.
C. Maximum Variation From Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.4 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.

END OF SECTION 08 33 23

SECTION 08 43 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed, exterior and interior manual-swing entrance doors, with vision glass.
B. Exterior and Interior aluminum-framed storefront systems.
C. Prefinished window paning.

1.2 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2025.
C. 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.
D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
E. AAMA 611 - Specification for Anodized Architectural Aluminum; 2026.
F. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2026.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E. ASTM 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; 2025.
F. 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; 2025.
G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
H. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
I. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
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; 2026.
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 E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation; 2022.
O. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
P. BHMA A156.21 - Thresholds; 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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.
    1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
    2. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
    3. 4. Include point-to-point wiring diagrams showing the following:
        a. Power requirements for each electrically operated door hardware.
        b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
D. Samples: Submit two samples 4 inches in size illustrating finished aluminum surface.
E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
F. Manufacturer's qualification statement.
G. Installer's qualification statement.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience and approved by manufacturer.

1.7 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

1.8 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.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide 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 installer.
    1. Warranty Period: **Five** years from date of Substantial Completion.
C. Finish Warranty: Provide 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.
    1. Warranty Period: **Ten** years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum-Framed Storefronts: 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. Kawneer North America: www.kawneer.com/#sle.
   2. EFCO, Inc.: ww.efcocorp.com/#ste
   3. Manko Window Systems, Inc: www.mankowindows.com/#sle.
   4. Tubelite, Inc: www.tubeliteinc.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.
   6. Obtain all components of storefront system, including framing, entrances, and accessories, from single manufacturer.
   7. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Wind Loads: **As indicated on Drawings.**

C. Other Design Loads: **As indicated on Drawings.**

D. Structural-Test Performance: Test according to ASTM E330/E330M as follows:
   1. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   2. Test Durations: 10 seconds.

E. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
   3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

F. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
   1. Design Displacement: As indicated on Drawings.
   2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.

G. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
   2. Maximum Water Leakage: In accordance with AAMA 501.1. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

I. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
   1. Thermal Transmittance (U-factor):
      a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
   2. Solar Heat Gain Coefficient (SHGC):
      a. Fixed Glazing and Framing Areas: Shall have a solar heat gain coefficient as indicated in glazing types.
   3. Air Leakage:
      a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.
      b. Single Door: Air leakage for the system of not more than 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.
      c. Pair of Doors: Air leakage for the system of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.
   4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.

J. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:
   1. Outdoor-Indoor Transmission Class: Minimum 26.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.
   2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
      a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 degrees F.
      b. Low Exterior Ambient-Air Temperature: 0 degrees F.
      c. Interior Ambient-Air Temperature: 75 degrees F.

2.3 EXTERIOR ALUMINUM-FRAMED STOREFRONT

A. Basis of Design: Kawneer Trifab Versaglaze 451T System (utlize 451T 113 Extra Heavy Weight vertical mullions where requried by delegated design calculations) or products of equivalent performance characteristics if approved substitution.

B. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Exterior Framing Construction: Thermally broken.
   2. Interior Vestibule Framing Construction: Thermally broken.
   3. Glazing System: Retained mechanically with gaskets on four sides unless noted on drawing.
   4. Fabrication Method: Field fabricated stick system.
   5. Glazing Position: Centered (front to back).
   6. Mullion Dimensions: 1 3/4" wide by 4 1/2" wide.
   7. Finish: Class I color anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   8. 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.

9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.4 INTERIOR ALUMINUM-FRAMED STOREFRONT

A. Basis of Design: Kawneer Trifab Versaglaze 450 System or products of equivalent performance characteristics if approved substitution.

B. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Glazing: Monolithic. Retained mechanically with gaskets on four sides unless noted on drawings.
2. Fabrication Method: Field fabricated stick system.
3. Glazing Position: Centered (front to back).
4. Mullion Dimensions: 1 3/4" wide by 4 1/2" wide.
5. Finish: Class I color anodized.
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.

2.5 EXTERIOR ENTRANCE DOOR SYSTEMS

A. Thermal entrance system. Basis of Design: Kawneer 500T Insulpour Thermal Entrances or products of equivalent performance characteristics if approved substitution.

1. Door Construction: **2 1/4 inch overall thickness**, with minimum 0.125 inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: **Wide Stile**
    a. Top and Side rails: 5 inch nominal width
    b. Bottom rail: 10 inch nominal width.
3. Glazing molding shall be 0.05" (1.3 mm) thick.
4. Glazing Stops and Gaskets: shall be either EPDM elastomeric extrusions or a thermoplastic elastomer
5. Provide adjustable glass jacks to help center the glass in the door opening.
6. Finish: Match adjacent storefront framing finish.

2.6 INTERIOR ENTRANCE DOOR SYSTEMS

A. Non-thermal entrance system. Basis of Design: Kawneer 500 Standard Entrances or products of equivalent performance characteristics if approved substitution.

1. Door Construction: **1 3/4 inch overall thickness**, with minimum 0.125 inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: **Wide Stile**
    a. Top and Side rails: 5 inch nominal width
    b. Bottom rail: 10 inch nominal width.
3. Glazing molding shall be 0.05" thick.
4. Glazing Stops and Gaskets: shall be either EPDM elastomeric extrusions or a thermoplastic elastomer
5. Provide adjustable glass jacks to help center the glass in the door opening.
6. Finish: Match adjacent storefront framing finish.

2.7 MATERIALS

A. Sheet and Plate Aluminum: ASTM B209/B209M.
B. Structural Profiles: ASTM B308/B308M.
C. Steel Reinforcement:
    1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
    2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
    3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
D. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.
E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
F. Glazing and Accessories: Comply with Section 08 80 00.

2.8 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
    1. Apply coating to exposed metal surfaces with proper preparation and pretreatment in accordance with resin manufacturer's instructions.

2.9 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."
B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.
    1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
    2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
    3. Opening-Force Requirements:
        a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
        b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
    1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
    2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
E. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
F. Weather Stripping: Manufacturer's standard replaceable components.
    1. Compression Type: Made of ASTM D2000, molded neoprene, or ASTM D 2287, molded PVC.
G. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
H. Drip Cap: Provide manufacturer's standard intregal drip cap over exterior entrances.
I. Silencers: BHMA A156.16, Grade 1.

J. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.10 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Rigid PVC filler.

2.11 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops.
   2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

A. General:
   1. Install wall system in accordance with manufacturer's instructions.
   2. Do not install damaged components.
   3. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   4. Provide alignment attachments and shims to permanently fasten system to building structure.
   5. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   6. Provide thermal isolation where components penetrate or disrupt building insulation.
   7. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   8. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
   9. Spray foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   10. Fit joints to produce hairline joints free of burrs and distortion.
   11. Rigidly secure non-movement joints.
   12. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   13. Seal perimeter and other joints watertight unless otherwise indicated.
B. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
D. Install components plumb and true in alignment with established lines and grades.
E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
F. Install glazing as specified in Section 088000 "Glazing."
G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. 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 directed by Architect.
    2. Conduct tests in each area prior to 35 percent completion of this work.
B. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
    1. Perform a minimum of two tests in areas as directed by Architect.
    2. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 35 percent completion.
C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.5 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.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.6 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13

This page intentionally left blank

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and infill panels.
   1. Conventionally glazed, with fiberglass pressure plate for increased thermal performance.
B. Pre-finished aluminum flashing and trim associated with curtain wall.

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
B. Section 05 50 00 - Metal Fabrications: Steel attachment devices.
C. Section 07 92 00 - Joint Sealants: Joint sealants and pre-compressed, self-expanding foam joint seals between frames and adjacent construction.
D. Section 08 43 13 - Aluminum-Framed Entrances and Storefronts: Other fenestration and entrance doors.
E. Section 08 80 00 - Glazing.
F. Section 12 24 00 - Window Shades: Attachments to framing members.
G. Single source supplier must supply compatible products under all related sections below or provide compatibility testing for materials that connect to or come in contact with the product being provided:
   1. Section 07 14 00 "Fluid-Applied Waterproofing / Dampproofing."
   2. Section 07 21 00 “Thermal Insulation” for insulation."
   3. Section 07 24 00 "Exterior Insulation & Finish System (EIFS)" for the air barrier and detail membranes within this system.
   4. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.
   5. Section 08 44 13 “Glazed Aluminum Curtain Walls” for extruded silicone air and vapor barrier transitions.

1.3 REFERENCE STANDARDS

A. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2025.
C. 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.
D. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2024.
E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
F. AAMA 611 - Specification for Anodized Architectural Aluminum; 2026.
A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2026.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E. ASTM 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; 2025.
F. 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; 2025.
G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
H. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
I. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
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; 2026.
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 E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation; 2022.
O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, finishes, and infill.
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.
    1. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
        a. Joinery, including concealed welds.
        b. Anchorage.
        c. Expansion provisions.
        d. Glazing.
        e. Flashing and drainage.
    2. Submit one sample of aluminum frame material illustrating surface finish.
D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure. Signed and sealed by the qualified professional engineer responsible for their preparation. ***Submit calculations with shop drawings for concurrent review. Architects and engineers will not proceed with initial review of curtain wall shop drawings without calculations.***
F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
G. Designer's Qualification Statement.
H. Installer's Qualification Statement.
I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located. **Submit calculations with shop drawings for concurrent review. Architects and engineers will not proceed with initial review of curtain wall shop drawings without calculations.**
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.

C. Energy Performance Standards: Comply with NFRC 100 for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
2. Manufacturer shall not modify framing depths from those indicated. If required, manufacturer shall provide internal aluminum or steel reinforcement of curtain wall members to meet Performance Requirements.
3. Manufacturer shall not revise direction or orientation of primary framing members as indicated.
4. Manufacturer shall not modify indicated attachment methods of curtain wall framing or support to adjacent construction.

1.7 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Refer to Section 01 43 39 Mock-ups for detailed requirements for integrated exterior mock-up.

C. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 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.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 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 installer.

1. Warranty Period: **Five** years from date of Substantial Completion.

C. Finish Warranty: Provide 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.

1. Warranty Period: **Ten** years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Basis of Design Manufacturer**: Kawneer North America. Available manufacturers offering products that may be incorporated into the Work include the following:

1. EFCO Corporation: www.efcocorp.com/ste#
2. Manko Window Systems, Inc: www.mankowindows.com/#sle.

3. Tubelite, Inc; www.tubeliteinc.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Obtain all components of curtain-wall system, including framing, entrances, and accessories, from single manufacturer.

C. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Wind Loads: **As indicated on Drawings.**

D. Other Design Loads: **As indicated on Drawings.**

E. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.

F. Structural-Test Performance: Test according to ASTM E330/E330M as follows:
1. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: 10 seconds.

G. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.
3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.

I. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

J. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
2. Maximum Water Leakage: In accordance with AAMA 501.1. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

K. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
   1. Thermal Transmittance (U-factor):
      a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
   2. Solar Heat Gain Coefficient (SHGC):
      a. Fixed Glazing and Framing Areas: Shall have a solar heat gain coefficient as indicated in glazing types.
   3. Air Leakage:
      a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.
   4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.

L. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:
   1. Outdoor-Indoor Transmission Class: Minimum 26.

M. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.
   2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
      a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 degrees F.
      b. Low Exterior Ambient-Air Temperature: 0 degrees F.
      c. Interior Ambient-Air Temperature: 75 degrees F.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEM

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Basis of Design: Kawneer 1600 System 1
   2. Outside glazed, with pressure plate and mullion cover at vertical and horizontal joints and perimeter mullions.
   3. Construction: Thermally broken.
   4. Fabrication Method: Field fabricated stick system.
   5. Glazing Method: Field glazed system.
   6. Vertical Mullion Dimensions: 2-1/2 inches wide by 7-1/2 inches deep.
   7. Pressure Plates:
      a. Manufacturer's thermally improved fiberglass components that mechanically retain glazing unless noted otherwise.
         1) Material shall be a fiberglass composite with a flexural strength of no less than 82 ksi along the lineal’s major axis.
         2) Material thermal conductivity shall be no more than 2 BTU•in/hr•ft2•Fº.
         3) Include snap-on aluminum trim that conceals fasteners.
   8. Finish: Class I natural anodized, to match Architect's sample.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

B. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.

C. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

D. 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.
E. Steel Reinforcement: As required by the manufacturer.
F. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
G. Glazing: Comply with Section 08 80 00.
H. Entrance Door Systems: Comply with Section 08 41 13 "Aluminum-Framed Entrances and Storefronts."

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.
B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
D. Fabricate components that, when assembled, have the following characteristics:
   1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
   2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
E. Factory-Assembled Frame Units:
   1. Rigidly secure non-movement joints.
   2. Seal joints watertight unless otherwise indicated.
   3. Install glazing to comply with requirements in Division 8 Section "Glazing."
F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 MATERIALS

A. Sheet and Plate Aluminum: ASTM B209/B209M.
B. Structural Profiles: ASTM B308/B308M.
C. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
D. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.
E. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

2.6 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (minimum) thick.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. Install curtain 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. Sill flashings are to be glazed into the CW systems as detailed.

G. Spray foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

I. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

J. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

K. Install components plumb and true in alignment with established lines and grades.

L. Seal joints watertight unless otherwise indicated.

M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 80 00 "Glazing."

3.4 TOLERANCES

A. A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
    d. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Provide Water-Spray Testing of installed curtain wall system by AAMA accredited independent laboratory 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 directed by Architect. Each test shall consist of a minimum area of 100 square feet.
    2. Conduct tests in each area prior to 35 percent completion of this work.
B. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.6 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, take care to remove dirt from corners, and wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION 08 44 13

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "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. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

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

B. DHI - Door and Hardware Institute

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 – 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. Not more than 2 weeks prior to beginning door, frame and hardware installation, installing contractor shall meet with the door hardware manufacturer to review installation and adjustment procedures, as well as UL and NFPA compliance, for all major types (locks, closers and exit devices).
   b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   c. Inspect and discuss preparatory work performed by other trades.
   d. Inspect and discuss electrical roughing-in for electrified door hardware.
   e. Review sequence of operation for each type of electrified door hardware.
   f. Review required testing, inspecting, and certifying procedures.
   g. 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) 10 years
        2) Exit Devices
            a) 10 years
        3) Closers
            a) 30 years
        4) Automatic Operators
            a) 2 years
    b. Electrical Warranty
        1) Exit Devices
            a) 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

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series
   b. McKinney TB 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

2. Acceptable Manufacturers:
    a. Roton
    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. Securitron CEPT-10
    b. Precision EPT-12C

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

2. Acceptable Manufacturers:
    a. Rockwood
    b. Trimco

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 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Corbin Russwin ML 2000 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
   a. Lever Design: NSA

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 99/33A series

2. Acceptable Manufacturers and Products:
   a. Precision APEX 2000 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.

3. Provide grooved touchpad type exit devices, fabricated from brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match the balance of door hardware.
4. Touchpad must extend a minimum of one-half of the door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with a deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices at pool gates 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 manufacturers' approved strikes.
9. Provide exit devices cut to the door width and height. Install exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.
10. Mount the mechanism case flush on the face of the doors or provide spacers to fill gaps behind the devices. Where glass trim or molding projects off the face of the 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 a type that can be removed by use of a keyed cylinder, which is self-locking when reinstalled.
13. Provide factory-drilled weep holes for exit devices used in full exterior applications, 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 the 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.
    a. Provide levers that return to within 1/2 inch (13 mm) of the door face.

17. Provide exit devices with PA filler.
18. Accessibility: Require not more than 5 lb. to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.
    a. Mechanical method: Von Duprin AX feature, where touchpad directly retracts the latchbolt with 5 lb. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb. requirement.
    b. Electrical method: Von Duprin's RX-QEL feature, where lightly pressing the touchpad with 5 lb. or less of force closes an electric switch, activating quiet electric latch retraction.

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 99/33A Series Outdoor Defense

2. Acceptable Manufacturers and Products:
   a. Detex Weatherized Series

B. Requirements:

1. Exit device must be designed to perform in outdoor conditions, and engineered to safeguard against moisture, temperature variations, and corrosion.

2. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
3. Provide Outdoor Defense exit devices for use in full exterior application, highly corrosive areas, and where noted in hardware sets.
4. Provide Outdoor Defense exit devices in Rim, Surface Vertical Rod, and Concealed Vertical Rod configuration.
5. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware[LE1] .
6. Cylinders: Refer to “KEYING” article, herein.
7. Provide smooth or touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
8. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
9. Provide exit devices with dead-latching feature for security and for future addition of alarm kits and/or other electrified requirements.
10. Provide flush end caps for exit devices.
11. Provide exit devices with manufacturers’ approved strikes.
12. 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.
13. 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.
14. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
15. 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.
16. 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.
17. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

C. Outdoor Defense Features:

1. Designed to perform in a variety of outdoor conditions and utilize a series of tests to ensure performance as intended in outdoor applications.
   a. Temperature range: -31 degrees Fahrenheit (-35 degrees Celsius) to 151 degrees Fahrenheit (66 degrees Celsius).
      1) Evaluated per UL294 Section 81 Variable Ambient Test
      2) Evaluated per UL1034 Section 34.2 Variable Ambient Test
   b. Moisture Resistance: Rain tested at 4.8 gallons per minute
      1) Per UL294 Section 79
      2) Per UL1034 Section 53
   c. Corrosion Resistance: Salt Fog Tested per
      1) UL294 Section 83.2 Salt Spray (5% salt concentration)
      2) UL1034 Section 52 Salt Spray Corrosion Test (20% salt concentration)
   d. Dust Resistance: Dust Tested per
      1) UL294 Section 80 Dust Test
      2) UL1034 Section 54 Dust Test

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. Precision ELR series
   b. Securitron BPS series

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. Match existing Corbin Russwin system

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner’s existing key system, 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. Existing factory registered system:

a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply 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.

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 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter 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 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4600 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.18 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Rockwood
   b. Trimco

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.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

B. Scheduled Manufacturer:

1. Zero International

C. Acceptable Manufacturers:

1. No Substitute

D. 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.

2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

E. 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.

F. 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.

G. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.

H. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.

I. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

J. Automatic Door Bottoms:

1. Provide closed cell sponge, bulb neoprene. or EPDM type of seal as specified in hardware sets.
2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.

K. 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

L. 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.

1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.20 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.

2.21 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 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. 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:

1) The hardware sets listed below represent design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process.

151753 OPT0483567 Version 2

Legend:
Link to catalog cut sheet
Electrified Opening

Door#	HwSet#
101	02.03
102	09.01
103	02.03
105A	07.02
105B	07.02
107A	07.02
107B	07.02
109A	07.02
109B	07.02
111A	07.02

Door#	HwSet#
111B	07.02
114A	03.03
115	07.03
117	02.05
118A	07.01
118B	07.01
118C	07.01
119	09.02
121-A	01.02
121-B	00.01

Door#	HwSet#
121C	06.01
121D	06.01
127-A	03.04
127-B	00.01
127C	08.02
127D	00.01
131-A	03.02
131B	08.01
131C	08.02
132	09.03

Door#	HwSet#
134	07.01
AAC01	02.02
AAC01A	03.01
AAL01	02.04
AAV01A	01.01
AAV01B	02.01
BBC01	08.02
EXB	00.02

Hardware Group No. 00.01 - OH DOOR

For use on Door #(s):
121-B 127-B 127D

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	NOTE	ALL HARDWARE BY OVERHEAD DOOR MANUFACTURER	UNF	BYO

Hardware Group No. 00.02

For use on Door #(s):
EXB

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PANIC HARDWARE	OUT-99-L-NL-06-WH-SNB	626	VON
1	EA	RIM CYLINDER	AS REQ'D	626	C-R
		NOTE	BALANCE OF HARDWARE BY GATE MFR		

BALANCE OF HARDWARE BY GATE MANUFACTURER.

Hardware Group No. 01.01

For use on Door #(s):
AAV01A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	112XY EPT			US28	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9947-EO-LBR-CON 24 VDC			626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9947-NL-OP-LBR-110MD-CON 24 VDC			626	VON
1	EA	RIM CYLINDER	AS REQ'D			626	C-R
2	EA	LONG DOOR PULL	9264F 36" 20" STD			630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC			689	LCN
1	EA	SURF. AUTO OPERATOR	4642 WMS 120 VAC			689	LCN
2	EA	ACTUATOR	8310-853T/8310-818T AS REQ'D			630	LCN
1	EA	BOLLARD	SQ25				WIK
1	EA	RAIN DRIP	142AA			AA	ZER
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.				UNK
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
2	EA	WIRE HARNESS	CON X LENGTH AS REQ'D				SCH
2	EA	WIRE HARNESS	CON-6W				SCH
2	EA	DOOR CONTACT	7764			628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC			LGR	SCE
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED				
			CARD READER BY OWNER				

OPERATIONAL DESCRIPTION
ACTIVE LEAF
CONCEALED ROD EXIT DEVICE. LESS BOTTOM ROD. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR. AUTO OPERATOR - PUSHING EITHER INTERIOR OR EXTERIOR ACTUATOR BUTTON TO CYCLE AUTO OPERATOR AFTER RETRACTING LATCHBOLT ELECTRICALLY. EXTERIOR ACTUATOR BUTTON ONLY ENERGIZED WHEN ACCESS CONTROL SOFTWARE OR AUTHORIZED CREDENTIAL RETRACTS LATCHBOLT ELECTRICALLY.

INACTIVE LEAF
CONCEALED ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL WHEN LATCHBOLT RETRACTED ELECTRICALLY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 01.02

For use on Door #(s):
121-A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-OP-110MD-CON 24 VDC			626	VON
1	EA	RIM CYLINDER	AS REQ'D			626	C-R
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O			630-316	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA MC			689	LCN
1	EA	WALL STOP	WS406/407CVX			630	IVE
1	EA	RAIN DRIP	142AA			AA	ZER
1	SET	GASKETING	328AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D				SCH
1	EA	WIRE HARNESS	CON-6W				SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
			CARD READER BY OWNER				

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.
SELF CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 02.01

For use on Door #(s):
AAV01B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	112XY			US28	
2	EA	DUMMY PUSH BAR	330			626	IVE
2	EA	LONG DOOR PULL	9264F 36" 20" STD			630-316	VON
1	EA	SURFACE CLOSER	4040XP SCUSH MC			689	IVE
1	EA	SURF. AUTO OPERATOR	4642 WMS 120 VAC		✓	689	LCN
1	EA	ACTUATOR, TOUCH	8310-855		✓		LCN
1	EA	ACTUATOR	8310-818T		✓		LCN
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.				
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED				UNK

OPERATIONAL DESCRIPTION
ACTIVE LEAF
DUMMY EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL. NON-LOCKING, NON-LATCHING.
AUTO OPERATOR - PUSHING EITHER INTERIOR OR EXTERIOR ACTUATOR BUTTON TO CYCLE AUTO OPERATOR.

INACTIVE LEAF
DUMMY EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL. NON-LOCKING, NON-LATCHING.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 02.02

For use on Door #(s):
AAC01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
2	EA	ELEC PANIC HARDWARE	RX-LC-9947-L-LBR-M996-06-FS-CON			626	VON
2	EA	RIM CYLINDER	AS REQ'D			626	C-R
2	EA	SURFACE CLOSER	4040XP RW/PA MC			689	LCN
2	EA	WALL STOP	WS406/407CVX			630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7800 SERIES AS REQ			689	LCN
2	EA	SILENCER HM	SR64			GRY	IVE
2	EA	WIRE HARNESS	CON X LENGTH AS REQ'D				SCH
2	EA	WIRE HARNESS	CON-6W				SCH
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
2	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D			BLK	SCE
1			CARD READER BY OWNER				

OPERATIONAL DESCRIPTION
CONCEALED ROD EXIT DEVICE. LESS BOTTOM ROD. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER. DOORS TO BE ON HOLD OPENS DURING REGULAR BUSINESS HOURS. ALWAYS FREE EGRESS. DOORS TO BE LOCKED AT NIGHT AND DURING EVENTS VIA ACCESS CONTROL. FAIL SAFE WITH RELEASE OF LOCKING WITH FIRE ALARM SYSTEM
RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.
SELF CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 02.03

For use on Door #(s):
101 103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC MORTISE LOCK	ML20906xSAF RX NSA			626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC			689	LCN
1	EA	WALL STOP	WS406/407CCV			630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7800 SERIES AS REQ			689	LCN
1	EA	GASKETING	488SBK PSA			BK	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D				SCH
1	EA	WIRE HARNESS	CON-6W				SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
1			CARD READER BY OWNER				

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. DOORS TO BE ON HOLD OPEN DURING NORMAL OPERATIONS.
UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING LEVER TO BE TURNED AND DOOR OPENED.
RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER.
SELF CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 02.04

For use on Door #(s):
AAL01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		US28	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
2	EA	ELEC PANIC HARDWARE	RX-LC-9947-L-LBR-M996-06-FS-CON		626	VON
2	EA	RIM CYLINDER	AS REQ'D		626	C-R
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.			UNK
2	EA	WIRE HARNESS	CON X LENGTH AS REQ'D			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
2	EA	DOOR CONTACT	7764		628	SCE
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC		LGR	SCE
	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			
1			CARD READER BY OWNER			

OPERATIONAL DESCRIPTION

BOTH LEAVES
CONCEALED ROD EXIT DEVICE. LESS BOTTOM ROD. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER. DOORS TO BE CLOSED WITH FREE INGRESS AND EGRESS DURING NORMAL OPERATIONS. ALWAYS FREE EGRESS. DOORS TO BE LOCKED AT NIGHT AND DURING EVENTS WITH ACCESS CONTROL SYSTEM. FAIL SAFE WITH RELEASE OF LOCKING WITH FIRE ALARM SYSTEM.
RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.
SELF CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 02.05

For use on Door #(s):
117

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC MORTISE LOCK	ML20906xSAF RX NSA			626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC			689	LCN
1	EA	WALL STOP	WS406/407CCV			630	IVE
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.				UNK
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D				SCH
1	EA	WIRE HARNESS	CON-6W				SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED				
			CARD READER BY OWNER				

OPERATIONAL DESCRIPTION
ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS.
ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING LEVER TO BE TURNED AND DOOR OPENED.
RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER.
SELF-CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

Hardware Group No. 03.01

For use on Door #(s):
AAC01A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		US28	IVE
1	EA	PANIC HARDWARE	99-EO		626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.			UNK
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	7764	✓	628	SCE
1	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. EXIT ONLY, NO EXTERIOR TRIM.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 03.02

For use on Door #(s):
131-A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	112XY			US28	IVE
1	EA	PANIC HARDWARE	CD-99-NL-OP-110MD			626	VON
1	EA	RIM CYLINDER	AS REQ'D			626	C-R
1	EA	MORTISE CYLINDER	AS REQ'D			626	C-R
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O			630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC			689	LCN
1	EA	RAIN DRIP	142AA			AA	ZER
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.				UNK
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	DOOR CONTACT	7764		✓	628	SCE
1	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED				

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY.
DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 03.03

For use on Door #(s):
114A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	STOREROOM LOCK	ML2057 NSA			626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC			689	LCN
1	EA	RAIN DRIP	142AA			AA	ZER
1	SET	GASKETING	328AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		✓	BLK	SCE

OPERATIONAL DESCRIPTION
STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.
SELF-CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 03.04

For use on Door #(s):
127-A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	112XY			US28	IVE
1	EA	PANIC HARDWARE	CD-99-NL-OP-110MD			626	VON
1	EA	RIM CYLINDER	AS REQ'D			626	C-R
1	EA	MORTISE CYLINDER	AS REQ'D			626	C-R
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O			630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC			689	LCN
1	SET	GASKETING	328AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		✓	BLK	SCE

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY.
DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.
DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 06.01

For use on Door #(s):
121C 121D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	ML2060 V10 NSA		626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION
PRIVACY LOCK - PUSH-BUTTON LOCKING. WHEN LOCKED, CAN BE OPENED FROM OUTSIDE WITH SMALL SCREWDRIVER. TURNING INSIDE LEVER OR CLOSING DOOR RELEASES BUTTON. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.
SELF CLOSING.

Hardware Group No. 07.01

For use on Door #(s):
118A 118B 118C 134

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ML2053 NSA		626	C-R
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 07.02

For use on Door #(s):

111A	105A	105B	107A	107B	109A
109B	111B				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ML2053 NSA		626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 07.03

For use on Door #(s):

115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	MORTISE LOCK	ML2053 x M34 NSA		626	C-R
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 08.01

For use on Door #(s):
131B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	CD-9947-L-DT-LBR-06		626	VON
1	EA	PANIC HARDWARE	CD-9947-L-LBR-06		626	VON
1	EA	RIM CYLINDER	AS REQ'D		626	C-R
2	EA	MORTISE CYLINDER	AS REQ'D		626	C-R
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
2	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

ACTIVE LEAF
CONCELEAD ROD EXIT DEVICE. LESS BOTTOM ROD. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER. DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF
CONCEALED ROD EXIT DEVICE. LESS BOTTOM ROD. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY LEVER WHEN DEVICE DOGGED DOWN. LEVER ALWAYS FIXED. DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 08.02

For use on Door #(s):
127C 131C BBC01

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	99-L-06		626	VON
1	EA	RIM CYLINDER	AS REQ'D		626	C-R
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 09.01

For use on Door #(s):
102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ML2057 NSA		626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.
SELF-CLOSING.

Hardware Group No. 09.02

For use on Door #(s):
119

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	99-L-NL-06		626	VON
1	EA	RIM CYLINDER	AS REQ'D		626	C-R
1	EA	MORTISE CYLINDER	AS REQ'D		626	C-R
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY FIXED LEVER AFTER RETRACTING LATCHBOLT WITH KEY. LEVER ALWAYS FIXED.
SELF-CLOSING.

Hardware Group No. 09.03

For use on Door #(s):
132

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
2	EA	MANUAL FLUSH BOLT HM	FB457		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	ML2057 NSA		626	C-R
1	EA	SURFACE CLOSER	4040XP HW/PA MC		689	LCN
2	EA	WALL STOP	WS406/407CVX		630	IVE
2	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION
ACTIVE LEAF
STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.
SELF CLOSING. HOLD OPEN INCLUDED.

INACTIVE LEAF
MANUAL FLUSH BOLTS.

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.
B. Monolithic glass units
C. Glazing products.
D. Glazing sealants.
E. Miscellaneous glazing materials.
F. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
    1. Windows.
    2. Doors.
    3. Glazed storefront
    4. Glazed curtain walls.
    5. Glazed entrances.
    6. Interior borrowed lites.

1.2 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
B. Section 08 43 13 - Aluminum-Framed Entrances and Storefronts: Glazing provided as part of storefront assembly.
C. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
D. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
D. ASTM C1036 - Standard Specification for Flat Glass; 2025.
E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.
I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
J. GANA (GM) - GANA Glazing Manual; 2022.
K. GANA (SM) - GANA Sealant Manual; 2008.
L. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
M. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2026.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.
B. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.
C. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.6 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit two sample 12 by 12 inch in size for each glass type.
E. Samples: Submit six inch long bead of glazing sealant, color as selected.
F. Certificate: Certify that products of this section meet or exceed specified requirements.
G. Installer's qualification statement.
H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.
J. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) 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 25 years of documented experience.
    1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
        a. Insulating Glass Certification Council (IGCC).
        b. Safety Glazing Certification Council (SGCC).
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.
    1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
        a. North American Contractor Certification (NACC) for glazing contractors.
        b. Equivalent independent third-party ANSI accredited certification.

1.8 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Refer to Section 01 43 39 Mock-ups for detailed requirements for stand alone mock-up.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.10 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.11 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
    1. Warranty Period: **Ten** years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide glazing assembly by Vitro Architectural Glass, or a comparable product by another manufacturer which meets all of the requirements of this section.
B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
D. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
    1. Design Pressure: Calculated in accordance with ASCE 7.
    2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
        a. Specified Design Wind Loads: As indicated on drawings.
        b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
            1) Load Duration: 60 seconds or less.
        c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
            1) For monolithic-glass lites heat-treated to resist wind loads.
            2) For insulating glass.
        d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
        e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
    3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
    4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.

C. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.

D. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

E. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

C. 1. Design Wind Pressures: As indicated on Drawings .

a. Wind Design Data: As indicated on Drawings.

2. Design Snow Loads: As indicated on Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick .
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.4 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction . Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
E. Minimum Glass Thickness for Exterior Lites: 6 mm .
    1. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
F. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.5 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.
B. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048. Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
    1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
C. Kind FT - Fully Tempered Type: Complies with ASTM C1048. Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
    1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.6 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.
B. Basis-of-Design Manufactuers: Provide Vitro Architectural Glass, or comparable product of other manufacturers approved by the Architect.
    1. General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
        a. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
        b. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
        c. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
    2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
    3. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
    4. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
        a. Spacer Width: As required for specified insulating glass unit.
        b. Spacer Height: Manufacturer's standard.
    5. Spacer Color: Black.
    6. Edge Seal:

a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
b. Color: Black.

7. Purge interpane space with dry air, hermetically sealed.

C. Type IG1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Basis-of-Design: **Equal to Vitro Solarban 70.**
3. Space between lites filled with argon.
4. Outboard Lite: Heat-strengthened float glass or fully tempered (where indicated), 1/4 inch thick, minimum.
a. Tint: Clear.
b. Coating: Solarban 70 Low-E (solar control type), on #2 surface.
5. Warm-edge spacer.
6. Inboard Lite: Heat-strengthened float glass or fully tempered (where indicated), 1/4 inch thick, minimum.
a. Tint: Clear.
7. Total Thickness: 1 inch.
8. Thermal Transmittance (U-Value), Winter - Center of Glass: Winter 0.24, maximum.
9. Visible Light Transmittance (VLT): 64 percent, minimum.
10. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
11. Visible Light Reflectance, Outside: 14 percent, maximum.

2.7 MONOLITHIC GLAZING UNITS

A. Type G1: Clear Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Fully tempered float glass.
3. Tint: Clear.
4. Thickness: 3/8 inch, nominal.
a. See drawings for locations.

2.8 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected by Architect from manufacturer's full range.
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.9 ACCESSORIES

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Neoprene.

2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

D. Setting Blocks: Elastomeric, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

E. Spacer Shims: Elastomeric, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

F. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

G. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

H. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

I. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION

A. Insulating Glass:
1. Shall comply with ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.
a. Units shall be certified for compliance by the IGCC in accordance with the above ASTM test method.
2. The unit overall thickness tolerance shall be -1/16” (1.59mm) / +1/16” (1.59mm) from nominal thickness in decimal form. Example: 1 1/8" (1.16" avg.) VRE1-59 Insulating Laminated Glass.
3. Shall comply with ASTM E 546 Standard Test Method for Frost Point of Sealed Insulating Glass Units
4. Shall comply with ASTM E 576 Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position
5. Sealed Insulating Glass Units to be double sealed with a primary seal of polyisobutylene or VTS™ and a secondary seal of silicone. Viracon Identification Number (VIN) to be discreetly laser printed onto VTS™ spacers. Each VIN code will provide detailed information such as an insulating glass unit’s thickness, size, substrate, print, heat treatment and manufacture date.
a. The minimum thickness of the secondary seal shall be 1/16” (1.59mm) for metal spacers and 5/32” (4.0 mm) for VTS™.
b. b. The target width of the primary polyisobutylene seal shall be 5/32” (3.97mm) and the target width of VTS™ shall be 1/4" (6.0 mm).
c. c. There shall be no voids or skips in the primary seal.
d. d. Voids between PIB or VTS and silicone are allowed up to 1/16 in. (1.6 mm) by 2 in. (51 mm) along lengths.
6. To provide a hermetically sealed and dehydrated space, lites shall be separated by an extruded VTS™ thermal plastic spacer.

B. Coated Vision Glass:
1. Shall comply with ASTM C 1376 Standard for Pyrolytic and Vacuum Deposition Coatings on Glass
2. Coated products to be magnetically sputtered vacuum deposition (MSVD)
3. Edge Deletion – When low-e coatings are used within an insulating unit, coating shall be edge deleted to completely seal the coating within the unit.

a. The edge deletion should be uniform in appearance (visually straight) and remove 95% of the coating.

PART 3 EXECUTION

3.1 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 the minimum required face and edge clearances are being provided.
C. 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.
D. Verify that sealing between joints of glass framing members has been completed effectively.
E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. 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.

3.3 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. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
C. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
    1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
    2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
I. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
J. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
K. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

L. 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.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.
B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
E. Place glazing tape on free perimeter of glazing in same manner described above.
F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
G. Carefully trim protruding tape with knife.

3.6 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
B. Place setting blocks at 1/4 points and install glazing pane or unit.
C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
D. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.7 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
C. Monitor and report installation procedures and unacceptable conditions.

3.8 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
D. Remove nonpermanent labels immediately after glazing installation is complete.
E. Clean glass and adjacent surfaces after sealants are fully cured.
F. 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.

3.9 PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

END OF SECTION 08 80 00

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.
2. Film-backed glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Binswanger Glass.
2. Guardian Industries Corp.
3. National Glass Industries.

B. Mirror Size: Refer to drawings for sizes

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.

1. Nominal Thickness: 5.0 mm .

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating approved by mirror manufacturer.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

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

a. Franklin International.
b. Liquid Nails Adhesive.
c. Royal Adhesives & Sealants, LLC.

2. Adhesive shall have a VOC content of 70 g/L or less.

2.4 MIRROR HARDWARE

A. Mirror Bottom Clips: Provide continuously mechanically fastened clip.

B. Mirror Top Clips: Provide continuously mechanically fastened clip.

2.5 FABRICATION

A. Mirror Edge Treatment: Flat high-polished. Seal edges of mirrors with edge sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Texture finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. American Gypsum.
b. CertainTeed Corporation.
c. Georgia-Pacific Building Products.
d. USG Corporation.

2. Thickness: 1/2 inch and 5/8 inch.

3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Accumetric LLC.
b. Hilti, Inc.
c. USG Corporation.

2.7 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Georgia-Pacific Building Products.
b. National Gypsum Company.
c. USG Corporation.
d. Requests for substitutions will be considered in accordance with provisions of Section 016000

2. Texture: Orange Peel

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C 840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At all other gyp. wall

    a. Primer and its application to surfaces are specified in Section 099000 "Interior Painting."

4. Level 5: Where indicated on drawings.

    a. Primer and its application to surfaces are specified in Section 09900 "Interior Painting."

H. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[matching approved mockup and] free of starved spots or other evidence of thin application or of application patterns.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glazed wall tile.
   2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

   1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
   3. Stone thresholds.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

   1. Installer is a Five-Star member of the National Tile Contractors Association.
   2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
   3. Installer employs only Ceramic Tile Education Foundation Certified Installers for Project.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS (Refer to drawings)

A. WT-1, Wall tile 1

1. Manufacturer: Subject to compliance with requirements, provide products by the following:

a. Basis of Design: Daltile Luminique Rectangle

1) Finish: Glossy
2) Tile Size: 12 x 24 Rectangle
3) Grout: To be selected from manufacturer's full range of colors.
4) Color: Arctic White

B. WT-2, Wall tile 2

1. Manufacturer: Subject to compliance with requirements, provide products by the following:

a. Basis of Design: Daltile Luminique Rectangle Fluted

1) Finish: Glossy
2) Tile Size: 12 x 24 Rectangle Fluted
3) Grout: To be selected from manufacturer's full range of colors.
4) Color: Arctic White

C. WT-3, Wall tile 3

1. Manufacturer: Subject to compliance with requirements, provide products by the following:

a. Basis of Design: Daltile Color Wheel Linear

1) Finish: Glossy
2) Tile Size: 6 x 18 rectangle
3) Grout: To be selected from manufacturer's full range of colors.

4) Color: Arctic White

D. Edge trim to be used with WT-3

1. Manufacturer: Subject to compliance with requirements, provide products by the following:

a. Basis of Design: Daltile Jolly

1) Finish: Glossy
2) Grout: To be selected from manufacturer's full range of colors.
3) Color: Arctic White

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Custom Building Products.
b. Georgia-Pacific Gypsum LLC.
c. USG Corporation.

2.4 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. For wall applications, provide nonsagging mortar.

2.5 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Custom Building Products.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2. Polymer Type:

a. Dry, redispersible form, prepackaged with other dry ingredients.
b. Liquid-latex form for addition to prepackaged dry-grout mix.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Schluter Systems L.P.

1) Top of Tile Wall Tile to Wall Transition: Schluter - JOLLY (top and outside edge)
2) Floor Tile to Concrete Floor Transition: Schluter - RENO-RAMP/-K.
3) Tile to Stair Nosing Transition: Schluter-TREP-E (Deductive Alternate #)

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Custom Building Products.
b. Laticrete International, Inc.

D. Stone Underlayment (Deductive Alternate #) - Install only on second floor under porcelain tile in it's entirety.

1. Basis-of-Design: EasyMat Tile & Stone Underlayment. www.custombuildingproducts.com

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with bonded mortar bed comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior tile floors.
    b. Tile floors in wet areas.
    c. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Wall Tile: 1/16 inch. Confirm this meets manufacturer's recommendation and notify architect if there is a conflict.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in mortar (thinset).

K. Metal Edge Strips: Install at locations indicated.

L. Floor Sealer: Apply floor sealer to[cementitious] grout joints[in tile floors] according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

M. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

N. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

O. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL TILE CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Metal edge moldings, transitions, and trims.

1.2 REFERENCE STANDARDS

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

B. ASTM 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.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

H. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 COORDINATION

A. Sequencing: Coordinate with the work of all trades above the ceiling and penetrating or supported by it. Do not start work until all appropriate work above the ceiling is complete.

B. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

C. Coordination: Coordinate with electrical, HVAC and fire protection trades to ensure edge configuration of light fixture, air diffusers shade pockets and sprinkler heads to penetrate or to lay in ceilings are proper for the system and provide system layout that accommodates lighting pattern.
   1. Notify Architect of discrepancies immediately.

1.5 SUBMITTALS

A. Product Data: Provide data on suspension system components and acoustical units.

B. Samples: Submit one sample 12 by 12 inch in size illustrating material and finish of each acoustical unit.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.6 QUALITY ASSURANCE

A. Source Limitations:
   1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.
   2. Suspension System: Obtain each type through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 68 percent prior to, during, and after acoustical unit installation.

1.9 WARRANTY

A. Acoustical Panels Manufacturer Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace acoustical tile that fails or is compromised that was created in and directly attributable to the manufacturer's manufacturing process within the specified warranty period.
   1. Warranty Period: 30 years from date of substantial completion.

B. Acoustical Panels Manufacturer Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace acoustical tile that fails or is compromised within the specified warranty period. Failed or compromised parts can include, but are not limited, to rusting (50% red rust as defined by ASTM B-117) or defects directly made by the manufacturer.
   1. Warranty Period: 40 years from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Basis-of-Design Product: "**Ultima Templok Tegular**" Ceiling System as manufactured by Armstrong Ceiling & Wall Solutions or comparable product approved by the Architect

B. Suspension Systems:
   1. Basis-of-Design Product: **Suprafine XL 9/16 inch Exposed Tee Seismic Rx** as manufactured by Armstrong Ceiling & Wall Solutions, or comparable product approved by the Architect by one of the following:
      a. Same as for acoustical units

   2. Basis-of-Design Product: **FrameAll Drywall Grid** as manufactured by Armstrong Ceiling & Wall Solutions or comparable product approved by the Architect

2.2 PERFORMANCE REQUIREMENTS

A. **Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 "Quality Requirements," to design seismic restraints for ceiling systems.**

B. **Seismic Performance: Comply with Seismic Category D. Suspended ceilings shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.**

C. Fire-Resistance Rating: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Class A in accordance with ASTM E84.
   2. Smoke-Develped Index: 50 or less.

2.3 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
   1. Classification: ASTM E1264, Class A
      a. Form: A2.2
      b. Pattern: "E" , fine texture
   2. Scrubbability: Withstands up to 150 scrub cycles using a scrubbability tester as per ATSM 02486.
   3. Size: 24 by 24 inches.
   4. Thickness: 3/4 inch.
   5. Light Reflectance: Not less than 0.80, determined in accordance with ASTM E1264.
   6. NRC Range: 0.75 to 0.85, determined in accordance with ASTM E1264.
   7. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with ASTM E1264.
   8. Panel Edge: Tegular
   9. Color: White.
   10. Suspension System Type 1: Exposed grid - white.

2.4 SUSPENSION SYSTEM(S)

A. Exposed Suspension System, Type 1: Hot-dipped galvanized steel grid with steel cap.
   1. Structural Classification: **Heavy duty** systems as identified in ICC-ESR-1308
   2. Profile: Tee; 9/16 inch face width.
   3. Finish: Baked enamel.
   4. Color: White

B. Drywall Grid System, Type 1: Follow Seismic Category D Installation Requirements

2.5 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
      a. Type: Postinstalled expansion Postinstalled bonded anchors.
      b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
      c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
      d. Corrosion Protection, Nickel-Copper Alloy: Components fabricated from nickel-copper-alloy rods complying with ASTM B164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.

C. Hangers, Braces, and Ties: type to suit application, seismic requirements, and ceiling system flatness requirement specified.

D. Seismic Clips: Manufacturer's clips for seismic conditions and to suit application.
1. Armstrong World Industries, Inc., “Uptight Clip”, or equal for metal suspension grid to cantilever past the soffit wall.

2.6 METAL EDGE MOLDINGS, TRANSITIONS, AND TRIMS

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

B. a. Pre-mitered corners

C. Extruded Aluminum Panel Transitions
1. Ceiling Trim Type: Armstrong World Industries, Inc., "Axiom Transitions," Straight transition panels, or equal at changes in ceiling height.
   a. Height: 2 inches or as indicated in the drawings.
   b. Types Required: ACT
   c. Color: White
   d. Construct Clouds to comply with Seismic Category D

D. TechZone Panels
1. 4” x 12” Panel, white

E. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

F. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

G. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that layout of hangers will not interfere with other work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

D. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   6. Do not attach hangers to steel deck tabs.

7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

D. Locate system on room axis according to reflected plan.

E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Re-tegular and paint all cut edges of tegular ceiling tiles.
6. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
7. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 5426 SUSPENDED WOOD CEILINGS

PART 1 — GENERAL

1.1 DESCRIPTION OF WORK

A. Work included: provide, coordinate and install suspended wood ceilings where shown on architectural drawings, and as specified in this specification. Coordination includes but is not limited to: lights, diffusers, speakers, microphones, and cameras.

1.2 QUALITY ASSURANCE

A. Suspended wood ceiling for this project shall maintain the quality as instituted by the architect and the Architectural Woodwork Institute/

B. Design criteria: linear open - felt backer system shall be installed true and plumb to within manufacturing tolerance of 1/8” within 8’ of length.

C. Product construction: wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.

1.3 SUBMITTALS

A. Technical data: submit manufacturer’s data and installation instructions.

B. Shop drawings: submit shop drawings showing all areas involved, attachment conditions and perimeter circumstances.

C. Submittal sample: submit 1 product sample for approval by architect.

1.4 DELIVERY, STORAGE AND HANDLING

A. Material must be stored and installed only in a secured ambient environment (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).

B. Windows, doors and all wet work must be completed before unpacking and installation. Handle carefully to avoid damage

1.5 WARRANTY

A. Provide manufacturer’s 1 year standard warranty.

B. The contractor shall warranty for one year all work from final acceptance of completed work.

PART 2 — PRODUCTS

2.1 BASIS OF DESIGN PRODUCT

A. RedBud Architectural Systems Linear Wood Ceiling Open Felt

1. RedBud Architectural Systems Linear Wood Ceiling Open Felt (or architect approved equal): Linear ¾" thick solid wood slats of varying widths (3 ¼" 5 ¼", and 7 ¼") installed end to end with concealed manufacturer provided "Black Liner Felt Clips" to form a continuous wood appearance. Black acoustical felt is factory installed to each slat, concealing the plenum and providing a high NRC.
2. **Red Bud Linear Open-Felt to be installed on seismic compliant drywall grid with screw attachment through the wood backer to the grid.**

B. Panel length –

1. Solid wood members shall be in 1' increments with overall fixed panel lengths of 2' up to 10'

C. Finish: wood finish shall utilize redbud clear finish with satin sheen. The back of planks shall be factory sealed.

D. Wood species shall be solid white oak.
(Note: veneered blades shall have matching edge banding on one long edge.)

PART 3 — EXECUTION

3.1 INSTALLATION

A. Linear open - felt backer system shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by the manufacturer.

B. The linear open - felt backer ceiling system shall be suspended by hd t-grid with main runners on 2' centers and cross t's every 4' minimally. Comply with seismic category D.

C. Contractor shall clean all panels prior to installation according to manufacturer's recommended maintenance procedures. Upon completion of installation, panels shall be inspected and cleaned as needed. END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 VINYL BASE (Indicated as "Resilient Base" on Drawings)

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Tarkett; www.commercial.tarkett.com

B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:
3.

a. Style A, Straight, Toeless – Typical
b. Style B, Straight, With Toe – Carpet Tile and Carpet Walk off Tile

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors and Patterns: WB3 – Tarkett – Silver Grey 055

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Miter corners to minimize open joints.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Provide owner 10% attic stock for each carpet type specified

PART 2 - PRODUCTS

2.1 CARPET TILE

2.2 Product:

A. Locations:
1. Entry Vestibule: Patcraft, Walk Forward, Moving 1053, Saunter 00560
2. Community Room: Shaw Contract Centered 18 x 36 5T492 Spontaneous 90505

B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns: Ashlar with pile direction parallel to next unit, set parallel to building lines

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 10113 - MAGNETIC-GLASS MARKERBOARDS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Coordinate magnetic-glass dry-erase markerboards with work before and after.

1.2 REFERENCE STANDARDS

A. American National Standard's Institute (ANSI) - latest edition:

1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

B. American Society for Testing Materials (ASTM) - latest edition:

1. ASTM B221 - Standard Specifications for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
2. ASTM C1036 - Standard Specification for Flat Glass.
3. ASTM C1048 – Standards Specification for Heat-Treated Flat Glass- Kind HS, Kind FT Coated and Uncoated.
4. ASTM C1172 – Standards Specification for Laminated Architectural Flat Glass.

1.3 SUBMITTALS

A. Shop Drawings: Provide shop drawings for each type of visual display board required.

1. Describe materials, design, finishes, trim, accessories, fastenings, and installation instructions,
2. Provide Manufacturer's installation and cleaning instructions.
3. State what preparation by other trades are needed.

B. Product Data: Provide technical data including Material Safety Data Sheets when applicable.

C. Samples: Provide samples to illustrate finish, color and texture where required.

1.4 QUALITY ASSURANCE

A. Manufacture's Qualifications: Manufacturer shall have a minimum of 5 years experience in the manufacture of visual display boards.

B. Operation and Maintenance: Include manufacturer's published data on regular cleaning, stain removal and precautions.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store material protected from exposure to harmful weather conditions and at temperatures and humidity conditions recommended by manufacturer.

PART 2 PRODUCTS

2.1 MAGNETIC GLASS DRY-ERASE MARKERBOARDS

A. Description: Frameless magnetic glass dry-erase boards.
   1. Glass: 1/4-inch thick, low-iron glass, extra-clear safety writing surface, flat polished edges with minimum 1/16" bevel.
   2. Writing Surface: Tempered Magnetic Glass, smooth finish for use with dry-erase marker.
   3. Dimensions: As Shoen Drawings.
   4. Back-Coated Color: To be selected by Architect from manufacturer's standard colors.
   5. Markers Caddy; Mounted on one side of boards with magnets, and containing eraser and 4 different color makers.
   6. Mounting Type: Edge to edge
   7. Wall fastenings: Hangers, brackets and anchors located to be invisible from room.
   8. Magnets: Include a set (minimum of two) of rare earth magnets for each board.
   9. Steel Backing Sheet Thickness (part of board assembly, this does not refer to wall blocking): 24 gauge minimum

B. Product / Producer:

   1. Magnetic Glass Markerboards, Invisi-Mount by Claridge
   2. Magnetic Glass Markerboards, Harmony by Ghent
   3. Magnetic Glass Markerboards, SPAN by Arrow Glassworks
   4. Magnetic Glass Markerboards, GMB by Nelson Adams NACO
   5. Equal product in quality and performance, approved by architect.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

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

   1. Verify that walls have been painted all coats and that paint is dry.
   2. Verify that grounds and wallboard reinforcement are in place.

3.2 INSTALLATION OF MARKERBOARDS

A. Install markerboards in locations and at mounting heights shown on Drawings. Install level and plumb, keeping perimeter trim straight in accordance with manufacturers recommendation.

B. Install units following manufacturer's current published recommendations and instructions, except as more stringently specified herein. Do not mount using mastics or adhesives. Fasten to walls mechanically, with concealed fasteners.

C. At completion of work, clean all surfaces and trim in accordance with manufacturer's recommendation, leaving all materials ready for use.

D. Deliver marker sets and eraser to designated location as instructed by owner.

END OF SECTION

SECTION 10 14 16 - PLAQUES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Plaques.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures 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.
D. Samples: One sample of each type of plaque sign, of size similar to that required for project, indicating style, font, and method of attachment.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package plaque signs as required to prevent damage before installation.
B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Plaques:
    1. A.R.K. Ramos: www.arkramos.com/#sle.
    2. Gemini Incorporated: www.geminimade.com/
    3. Matthews Architectural Products: www.matthewsarchitectural.com/
    4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PLAQUES

A. Metal Plaques:
    1. Basis of Design: Provide A.R.K. Ramos; Etched Plaques: www.arkramos.com or products of equivalent performance characteristics if approved substitution
    2. Material: Aluminum sheet, flat, etched.
    3. Material Thickness: 1/4 inch.
    4. Size: As indicated on drawings.
    5. Text and Typeface:
        a. Character Font: Coordinate with Owner and Architect.
        b. Character Case: Upper and lower case (title case).
        c. Character Color: Contrast with background color.
    6. Surface Finish: As selected by Architect from manufacturer's full range.
    7. Protective Coating: Manufacturer's standard clear coating.
    8. Mounting: Concealed studs..

2.3 ACCESSORIES

A. Mounting Fasteners:

1. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Locate plaque signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
D. Protect from damage during construction; repair or replace damaged items.

END OF SECTION 10 14 16

SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dimensional letter signage.
B. Illumination system.

1.2 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. UL 879 - Electric Sign Components; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
C. Shop Drawings:
    1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
    2. Show locations of electrical service connections.
    3. Include diagrams for power, signal, and control wiring.
D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.
B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Dimensional Letter Signs:
    1. A.R.K. Ramos: www.arkramos.com/#sle.
    2. Gemini Incorporated: www.geminimade.com/
    3. Matthews Architectural Products: www.matthewsarchitectural.com/
    4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DIMENSIONAL LETTERS

A. Metal Letters:
    1. Material: Aluminum sheet.
    2. **Special Note: Refer to drawing note regarding entire sign to be cut from a single sheet of aluminum, with panel seams located as noted.**
    3. Thickness: Manufacturer's standard for letter size.
    4. Letter Height: As indicated on drawings.
    5. Text and Typeface:
        a. Character Font: As indicated on drawings.
    6. Finish: As selected by Architect from manufacturer's full range.
    7. Color: Clear anodized..
    8. Mounting: Concealed studs,2 inch stand off per drawings.

9. Illumination System: LED tape light, per MEP, as indicated on drawings.
    a. Provide products that are listed and labeled as complying with UL 879, where applicable.
    b. Power: 120 V, 60 Hz, 1 phase, 15 A.

2.3 ACCESSORIES

A. Mounting Fasteners:
    1. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated. Noncorroding material.
B. Electrical Components and Devices: Listed and labeled as defined in NFPA 70 by a qualified testing agency.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Verify that electrical service is correctly sized and located to accommodate dimensional letter signs.
C. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Protect from damage during construction; repair or replace damaged items.

END OF SECTION 10 14 19

SECTION 10 21 13 TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid plastic toilet compartments including the following: (ARIA)
   1. Floor mounted toilet compartments.
   2. Wall mounted urinal screens.

1.2 RELATED WORK

A. Section 05 50 00 - Metal Fabrications.

B. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A 666 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   2. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 SUBMITTALS

A. 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.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include coordinated dimensions for equipment and furnishings specified in other Sections.

C. Verification Samples: For each finish product specified, two samples, representing actual product, color, and finish.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment, cleaning and maintenance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Five years or more experience in manufacture of laboratory casework and equipment of type specified.

B. Installer: Five years or more experience with installation of similar products, and acceptable to the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in the manufacturer's unopened packaging until ready for installation.

B. Protect finished surfaces from soiling or damage during handling and installation.

1.7 COORDINATION AND SCHEDULING

A. Schedule delivery of access flooring so that spaces are sufficiently complete and access flooring materials can be installed immediately following delivery.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard 25 year limited warranty for against breakage, corrosion, and delamination under normal conditions.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturer: Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505; Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email:request info (info@scrantonproducts.com); Web:http://www.scrantonproducts.com
   1. Fabricator: Santana Toilet Partitions.
   2. Fabricator: Comtec Toilet Partitions.
   3. Fabricator: Capitol Toilet Partitions.

B. Substitutions: Not permitted.

2.2 MATERIALS

A. Doors, Panels and Pilasters:
   1. High density polyethylene (HDPE), fabricated from polymer resins compounded under high pressure, forming single thickness panel.
   2. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
   3. Thickness: 1 inch (25 mm) with 1/4 inch (6 mm) radiused edges. One edge of pilaster and transom panels to be ship lapped.

B. Stainless Steel: ASTM A167, Type 304.

2.3 TOILET COMPARTMENT SYSTEM

A. Basis of Design: ARIA Toilet Partitions as manufactured by and supplied by Scranton Products.
   1. Style: Full height floor mounted overhead braced toilet compartments.

B. System Construction:

1. Doors: 68 inches (1727 mm) high. Mounted 12 inches (305 mm) above finished floor.
   a. Trim: Application to hide seam gap between dividing panels.
2. Pilasters: System specified height, shoeless system secured with 3/4 inch (19 mm) long stainless steel tamper resistant Torx head screws and angled wall brackets.
3. Transom Panel: Height required to accommodate specified system height with ship lap on one edge. Mounted with four mending plates using 3/4 inch (19 mm) long stainless steel tamper resistant Torx head screws.
4. Wall Brackets: 54 inches (1372 mm) long, heavy-duty aluminum with bright dip anodized finish. Mounts to pilasters, panels and walls with 3/4 inch (19 mm) long stainless steel tamper resistant Torx head screws.

C. System Design:
1. Door Design: Traditional Series; Model 1000.
2. Side Panel Design: Plain (standard).
3. Color: Metallic; Stainless. Texture: Grip-Ex.
4. Trim: As determined by the Architect from Manufacturer's full line of selection.
5. Trim Color: As determined by the Architect from Manufacturer's full line selection.

2.4 HARDWARE:

A. Hinges: Helix style 78 inches (1981 mm) edge mounted continuous hinge.
1. Stainless steel: 0.074 inch (1.88 mm) thick 304-2B stainless steel using a stainless-steel pin in 0.234 inch (5.94 mm) diameter.
2. Closing degree is minus 5 degrees. Hinge is designed to come to a full close on its own weight.

B. Occupancy Indicator Latch and Housing: Satin stainless-steel showing green and red occupancy indicators.
1. Latch housing: Satin stainless steel.
2. Slide bolt and button: Satin stainless steel.
3. Door Pulls: Satin stainless steel.

C. Coat Hook and Bumper:
1. Combination type, chrome plated Zamak.
2. Equip outswing handicapped doors with second door pull and door stop.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas receiving toilet partitions, panels and pilasters for correct height and spacing of anchorage, blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the Architect.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install partitions rigid, straight, plumb, and level manor, with items laid out as shown on shop drawings.

C. Clearance at vertical edges of doors shall be uniform top to bottom.

D. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.

E. Buff edges of panels if sharp.

F. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.4 PROTECTION

A. Take protective measures to prevent exposure to other construction activity.

B. Protect installed products until completion of project.

3.5 CLEANING

A. Clean surfaces to remove soiling, stains, dust, and dirt using materials acceptable to manufacturer.

B. Touch-up, repair or replace damaged products and defective work, as directed by Architect.

C. Leave installation area clean, free of residue and debris resulting from work of this Section.

END OF SECTION

SECTION 10 22 26 OPERABLE PARTITIONS

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. Manually operated, individual panel operable partitions.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
E. Indoor Air Quality: Operable partition, movable wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

1.4 REFERENCE STANDARDS

A. ASTM International
    1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E84 - Surface Burning Characteristics of Building Materials.
4. ASTM E413 - Classification for Rating Sound Insulation

B. Health Product Declaration Collaborative
1. Health Product Declaration Open Standard v2.1

C. International Standards Organization
1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards
1. ADA – Americans with Disabilities Act
2. UL 508A – Standard for Industrial Control Panels
3. NFPA 70 – National Electrical Code

1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.

B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.

C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.

D. Samples: Color samples demonstrating full range of finishes available. Verification samples will be available in same thickness and material indicated for the work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
B. Warranty period: Ten 10 years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATIONS

A. Products
    1. TRNG 104/LOBBY 105: Acousti-Seal Encore™ – Single Panel: Manually operated individual panel operable partition or architect approved equal.

2.2 OPERATION

A. TRNG 104/LOBBY 105: Acousti-Seal Encore™ – Single Panel: Series of individual flat panels, manually operated, top supported with operable floor seals and automatic top seals.
B. Final Closure:
    1. TRNG 104/LOBBY 105: Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION

A. Nominal 4-1/4-inch (108mm) thick panels in manufacturer's standard 51-inch (1295mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
B. Panel skin shall be:
    1. TRNG 104/LOBBY 105: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
        a. 54 STC - 21-gage steel
C. Hinges for Pass Doors and Pocket Doors shall be:
    1. TRNG 104/LOBBY 105: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to

frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

2. TRNG 104/LOBBY 105: Concealed laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Lifetime Warranty on hinges. Concealed hinges mounted into panel edge or vertical astragal are not acceptable.

D. Panel Trim: No vertical or horizontal trim required or allowed on edges of panels; minimal groove appearance at panel joints.

E. Panel Weights:

1. TRNG 104/LOBBY 105: 54 STC - 9.5 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be factory applied, Class "A" rated material. Finish shall be:

1. TRNG 104/LOBBY 105: Reinforced vinyl with woven backing weighing not less than 20 ounces (567 grams) per lineal yard. Color to be selected by architect from full line.

B. Panel Trim: Exposed panel trim of one consistent color:

1. TRNG 104/LOBBY 105: Color to be selected by architect from full line.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Aluminum astragals, with tongue and groove configuration in each panel edge. Rigid plastic astragals are not acceptable.

B. Horizontal Top Seals shall be Modernfold SureSet™ automatic operable top seals, manually operated top seals not required or permitted.

C. Horizontal bottom floor seals shall be Modernfold Sureset™ bottom seal:

1. TRNG 104/LOBBY 105: SA2 - Automatic bottom seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to –1-1/2-inch (38 mm) which automatically drop as panels are positioned, without the need for tools or cranks. Extended seal shall exert nominal 120 pounds (54 kg) downward force to the floor throughout operating range.

2. TRNG 104/LOBBY 105: SA2E – Automatic bottom seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to –1-1/2-inch (38 mm) which automatically drop as panels are positioned and final closure made, without the need for tools or cranks.

2.6 SUSPENSION SYSTEM

A. TRNG 104/LOBBY 105: #14 Suspension System
    1. Suspension Tracks: Minimum 7-gage, 0.18-inch (5 mm) roll-formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support by pairs of 1/2-inch (13 mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
        a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
    2. Carriers: All-steel trolleys with steel tired ball bearing wheels.
    3. Warranty period: Ten (10) years.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of

operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Owner's representative.
B. Provide Operation and Maintenance Manual to Owner's representative.

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.
2. End wall guards.
3. Chair rail
4. Sheet protection

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. applied in any direction.
2. Concentrated load of 200 lbf applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

1.3 ACTION SUBMITTALS

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

B. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.

1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
2. Chemical and Stain Resistance: Tested according to [ASTM D 543] [ASTM D 1308] <Insert test standard>.
3. Self-extinguishing when tested according to ASTM D 635.
4. Flame-Spread Index: 25 or less.
5. Smoke-Developed Index: 450 or less.

B. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 CORNER GUARDS, END GUARDS, CHAIR RAIL

A. CG-1: Inpro Tape-On Corner Guards Assembly or architect approved equal
1. Inpro Tape On Corner Guard, 1 ½” Wings, 8’ Length, White Sand 0103
2. Adhesive as required per manufacturer’s recommendations

B. CG-2: Inpro 160F Flush Mount Corner Guard Assembly or architect approved equal
1. Inpro 160 V Vinyl Cover 2” Wings, 8’ Length: White Sand 0103
2. Inpro 160 V Top Cap Closure: White Sand 0103
3. 1612FA Aluminum Retainer

C. CG-SS: Inpro Stainless Steel Corner Guard Assembly or architect approved equal

1. Inpro Surface Mount Stainless Steel Corner or architect approved equal
    a. 2” Wings, Full Wall Height
    b. Type 430 Stainless Steel, 16 Gauge
    c. Surface Mount “Cement On” installation without screws
2. Field applied heavy duty adhesive per manufacturer’s recommendations

D. EG-SS: Inpro Surface Mount Stainless Steel End Wall Protector Assembly or architect approved equal
    1. Inpro Surface Mount Stainless Steel End Wall Protector
        a. 2” Wings, Full Wall Height, Verify in Field End Wall Width
        b. Type 430 Stainless Steel, 16 Gauge
        c. Surface Mount “Cement On” installation without screws
    2. Field applied heavy duty adhesive per manufacturer’s recommendations

E. Chair Rail Assembly
    1. Inpro 1400 Wall Guard or architect approved equal
        a. 1400V Vinyl Cover, White Sand 0103
        b. G2-1400B Continuous Impact Bumper
        c. 1420A Continuous Aluminum Retainer
        d. 1402 End Cap – Use Typically at the each end of every run
        e. 1407 Inside Corners – Use at the computer lab for continuous unbroken wall protection

F. Stainless Steel Sheet Wall Panel
    1. Inpro Stainless Steel Wall Panels or architect approved equal. Provide stainless steel wall panel systems that include panels, top cap, divider trim, inside and outside corner trim.
        a. Panel Size: 4’ (122cm) x 8' (244cm)
        b. Panel Thickness: 16 gauge Stainless Steel - Type 304 (type 304 conforms to NSF Standard 51)

    2. Stainless Steel Inside and Outside Corner Trim
        a. a. 1” (25mm) x 1” (25mm), 24 gauge. 120" (3048mm) Height. Receives edge of adjacent panel. Stainless Steel - Type 304 (type 304 conforms to NSF Standard 51). Attachment: Adhesive mount

    3. Stainless Steel Top Caps
        a. 1” (25mm) sightline, 24 gauge. 120" (3048mm) Length. Receives top edge of panels. Stainless Steel - Type 304 (type 304 conforms to NSF Standard 51). Attachment: Adhesive mount.

    4. Stainless Steel Divider Trim
        a. 1” (25mm) sightline, 24 gauge. 120" (3048mm) Height. Receives edge of adjacent panel. Stainless Steel - Type 304 (type 304 conforms to NSF Standard 51). Attachment: Adhesive mount

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examination:
   1. Examine areas and conditions in which the wall panel systems will be installed.
      a. Complete all finishing operations, including painting, before beginning installation of wall panel system materials
   2. Wall surface shall be dry and free from dirt, grease and loose paint.

B. Preparation:
   1. Prior to installation, clean the substrate to remove dust, debris and loose particles. Ensure the substrate is sound and per project plans
   2. Acclimate product in temperatures between 65°F and 80°F [18°-27°C] and a humidity level less than 80% 24 hours in advance of installation.
   3. The area of installation must temperature and humidity controlled.

C. General: Install wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

   1. Install wall protection units in locations and at mounting heights indicated on Drawings.
   2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

      a. Provide anchoring devices to withstand imposed loads.

D. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

E. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Under lavatory guard
3. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Grab Bar

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, www.bobrick.com or comparable product by one of the following:

a. A&J Washroom Accessories, Inc.
b. American Specialties, Inc.; ASI Group.
c. Bradley Corporation.
d. Substitutions: Refer to section 016000 "Product Requirements" and Section 012500 "Substitution Procedures" <Insert manufacturer's name>.

2. Bar sizes/Product:

a. B-6806.99 x 36" grab bar by Bobrick (**Labeled A** in Accessory Schedule in Drawings).

b. B-6806.99 x 42" grab bar by Bobrick **(Labeled B** in Accessory Schedule in Drawings).

c. B-6806.99 x 18" grab bar by Bobrick (**Labeled C** in Accessory Schedule in Drawings).

3. Mounting: Flanges with exposed fasteners.

B. Toilet Paper Dispenser (**Labeled D** in Accessory Schedule in Drawings)

1. Tork OptiServe Coreless 2-Roll Toilet Paper Dispenser, 558060, lockable, white

C. Sanitary-Napkin Disposal Unit (**Labeled E** in Accessory Schedule in Drawings)

1. Basis-of-Design Product: Subject to compliance with requirements, provide surface-mounted sanitary napkin disposal by Bobrick, www.bobrick.com, model #B-270 or comparable product by one of the following:

   a. A&J Washroom Accessories, Inc.
   b. American Specialties, Inc.; ASI Group.
   c. Bradley Corporation.

2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin) .

D. Soap Dispenser (**Labeled F** in Accessory Schedule in Drawings)
1. Tork manual soap and sanitizer dispenser, wall and mirror mounted; Tork 581500, lockable, white

E. Paper Towel Dispenser (**Labeled G** in Accessory Schedule in Drawings)

1. Tork Peak Serve Mini Continuous Hand Tower Dispenser, White, 552530

F. Trash Receptable (**Labeled H** in Accessory Schedule in Drawings)

1. Bobrick Semi-Recessed Waste Receptacle, Satin-Finish Stainless Steel

G. Mirror Unit (**Labeled I)**

1. Manufacturers: Subject to compliance with requirements, Basis of Design: Bradley Model #781, 24 x 36 frame mirror unit or provided by one of the following:

   a. ASI-American Specialties, Inc.
   b. Bradley Corporation.

2. Frame: Stainless steel angle, 0.05 inch thick.

   a. Corners: Mitered and mechanically interlocked.

3. Size: 24"W x 36"H .

4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

H. Coat Hook (**Labeled J**)

1. Bobrick B-671, Stainless Steel with Satin Finish, 2” x 2” flange, 1 ½” high x 1 ¼” wide hook, projects 2” from wall

2. Locations

a. Every toilet partition door

b. Back of door at all single toilet restrooms

2.3 UNDERLAVATORY GUARDS

A. Under lavatory Guard:

1. Manufacturers, listed below, or other architect approved equal

a. Buckaroos, Inc.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.

3. Material and Finish: Antimicrobial, molded plastic, white.

2.4 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder (**Labeled K** in the Accessory Schedule in Drawings) :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick; www.bobrick.com, model #B-239 x 34 shelf with mop and broom holder/hooks; product name or designation> or comparable product by one of the following:

a. Bobrick Washroom Equipment, Inc.
b. Substitutions: Refer to Section 016000 "Product Requirements" and Section 012500 "Substutition Procedures"<Insert manufacturer's name>.

2.5 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ansul Incorporated.
b. Larsens Manufacturing Company.
c. Substitutions: See Section 016000 - Product Requirements.

B. Multipurpose Dry-Chemical Type, model #MP10 UL-rated 4A:80B:C nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container (one per cabinet).

1. Capacity to combat Class A, Class B, and Class C Fires.

C. FIRE CABINET (Refer to drawings for quantities and locations).

Product: Model #FA 2409-R7 by Larsen Manufacturing; www.larenmfg.com.

1. Cabinet for up to 10 lbs ABC Fire Extinguisher, steel door, and frame,
   a. Cabinet Type: Semi-Recessed (Projects 1 ½")
   b. Cabinet Finish: Baked Enamel, White
   c. Cabinet Size: 24" height x 9.5" wide x 6" depth.
   d. Cabinet Door: "Full Panel Glazing", no lock
2. Mounting Height: 48" above finished floor to top cabinet handle (field verify before installation).

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

   a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knocked-down lockers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Include locker identification system and numbering sequence.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in ICC A117.1.

2.2 KNOCKED-DOWN CORRIDOR LOCKERS (Refer to drawings for layout/counts)

A. Basis of Design Product: Custom Version of Hadrian Emperor Lockers, 4 tier, 1'6 x 1'6" x 1'6" unit lockers, continuous closed base and continuous closed sides, continuous sloped top, each unit to have one double prong hook, each unit to have a recessed door handle & latch.

B. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
2. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
3. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

E. Hinges:

1. Continuous Hinges: Manufacturer's standard, steel, full height.
2. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

F. Projecting Door Handle and Latch: Finger-lift latch control designed for use with padlocks; positive automatic latching, chromium plated; pry and vandal resistant.

1. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

G. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

H. Locks: Combination padlocks.

I. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

J. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

K. Coat Rods: Manufacturer's standard.

L. Continuous Zee Base: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.

1. Height: 4 inches.

M. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

N. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

O. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.

P. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range <Insert color>.

2.3 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. All Units: One double-prong ceiling hook

D. Knocked-Down Construction: Fabricate metal lockers by preassembling at plant prior to shipping, using manufacturer's nuts, bolts, screws, or rivets.

E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

F. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

G. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

J. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

L. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

M. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

N. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
3. Anchor back-to-back metal lockers to floor.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.

4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

END OF SECTION

SECTION 122413 – MANUAL ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. MechoShade Systems, Inc.; www.mechoshade.com
2. Substitutions: Refer to Section 016000 - "Product Requirements" and Section 012500 "Substitution Procedures"

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Chain-Retainer Type: Clip, jamb mount .
2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Shade fabric as manufactured by MechoShade Systems LLC:

a. Series: Soho 1900.
b. Type: PVC and polyester blend
c. Weave: 2 x 2 Basketweave
d. Openness Factor: 5 percent.
e. Color: 1905 Dove Grey

2.4 ROLLER SHADE COMPONENTS AND REQUIREMENTS

A. Access and Material Requirements

1. Provide shade hardware allowing for the removal of shade roller tube frombrackets without removing hardware from opening and without requiring end or center supports to be removed.
2. Provide shade hardware that allows for removal and re-mounting of the shadebands without having to remove the shade tube, drive or operating support brackets

B. Manual Operated Chain Drive Hardware and Brackets:

1. Provide for universal, regular and offset drive capability which enables the drive chain to always fall in front of the fabric plane.
2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
5. Provide shade hardware system that allows multi-banded, manually-operatedshades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of the drive mechanism to the shade roller tube. Friction-fit connectors for the drive mechanism connection to the shade roller tube are not acceptable.
7. Provide shade hardware constructed of minimum 16 gage, .060 inch (1.52 mm) thick plate steel or heavier as required to support 150 percent of the full weight of each shade

C. Drive Bracket / Brake Assembly:

1. Bracket model shall be fully integrated with all accessories including, but not limited to: fascia, room darkening side/sill channels, center supports and connectors for multi-banded shades

2. Bracket and brake assembly shall rotate and be supported on a welded 5/16 inch (8 mm) steel pin

3. The brake shall be an over-running wrapped spring clutch design which disengages during the raising and lowering of a shade. The brake shall withstand a minimum pull force of 50 lbs (22 kg) in the stopped position.

4. 4. The braking mechanism shall employ an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes a wrapped spring clutch assembly that ensures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated requiring no maintenance. Products that require externally applied lubrication and/or are not permanently lubricated are not acceptable.

5. The entire assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments

D. Drive Chain: No. 10 qualified stainless steel chain rated to 100 lbs (45 kg) minimum breaking strength. Nickel plate chain shall not be acceptable.

2.5 ACCESSORIES

A. Fascia:

1. Continuous removable extruded aluminum fascia that attaches to shade mountingbrackets without the use of adhesives, magnetic strips, or exposed fasteners.

2. Fascia shall be able to be installed across two or more shade bands in one piece.

3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.

4. Provide bracket/fascia end caps where mounting conditions expose outside of roller shade brackets.

5. Fascia shall include a channel for application of flexible material to closing off any light leakage between the fascia and a window frame, mullion, ceiling and/or any other horizontal surface

6. Fascia shall attach directly to the roller shade bracket without the need to install additional mounting hardware. Exposed fasteners shall not be allowed.

7. Fascia shall positively lock in a top-down installation method to help prevent accidental damage

PART 3 - EXECUTION

3.1 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed plus or minus 0.125 inches (3mm), and to assure the alignment between EDU groups, which shall not exceed plus or minus 0.25 inches (6 mm).
2. Be responsible for field inspection on an area-by-area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop rawings.
3. Provide accurate field measurements to 1/16 inch (1.6 mm) for custom shade fabrication on the roller shades manufacturer's input forms.
4. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 12496 MOTORIZED WINDOW ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roller shades, motorized operation and accessories.
   1. Intelligent encoded electronic drive system.
   2. Motor controls, interfaces, and accessories.

B. Roller shades, manual

C. Shade fabric.

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.

B. Section 09260 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.

C. Section 09510 - Acoustical Ceilings: Coordination with acoustical ceiling systems for installation of shade pockets, closures and related accessories.

D. Division 26 - Electrical: Electric service for motor controls. Electrical and low voltage requirements, internal communication, data transfer, and connection to the Internet and local PoE switches as required.

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM G21 and E 2180 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Cradle to Cradle Products Innovation Institute (C2C):
   1. C2C (DIR) - C2C Certified Products Registry.

C. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   2. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

D. Underwriters Laboratories (UL):
   1. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
   2. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

E. Window Covering Manufacturers Association (WCMA):
   1. WCMA A100.1 - Safety of Window Covering Products; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
   2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
   2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
   1. Preparation instructions and recommendations.
   2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes , accessories, and operating instructions.
   3. Storage and handling requirements and recommendations.
   4. Mounting details and installation methods.
   5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.
   6. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
   7. Motorized Shades: Power requirements. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.
      a. If using PoE motors, include integration of PoE motor hubs, shade motors, wall controllers, software programming, ability to integrate with building management system, audiovisual and lighting control systems as applicable.Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
   1. Provide location plan showing all motor locations, switch locations and control zones as per the performance requirements of the specifications. All switches, sensors and other control accessories must clearly be shown and called out in a bill of materials.
   2. Provide elevation drawings showing shade band layout. Indicate any necessary seam or batten locations and align with horizontal mullions where possible.

A. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

B. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.

3. Shadecloth Sample: Mark face of material to indicate interior faces.Verification Samples: 6 inches (150 mm) square, representing actual materials, color and pattern.

C. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.6 QUALITY ASSURANCE

A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.

C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
   1. Requirements for Roller Shade Installer/Contractor:
      a. Roller Shade Hardware, shade fabric, motor, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
      b. Roller Shade Installer/Contractor shall list all components and systems included in their bid, including but not limited to, the prime manufacturer of the motor control and automated equipment and shall be financially responsible for any change orders and/or back charges required by the BMS, AV, or Lighting Control Systems contractors to interface with the automatic solar tracking system and the motorized roller shade system.
      c. If using PoE motors, installer for roller shade system shall be trained and certified by all manufacturers involved including IP gateway, PoE motor hubs, COAP protocol wall controllers, EnOcean enabled keypads and sensors, UPoE+ switch and be capable of complete deployment of controls, software and hardware.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

E. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

F. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

G. Requirements for Electronic Hardware, Controls, and Switches: Roller shade hardware, shade fabric, EDU (Electronic Drive Unit), and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
   1. If using PoE motors, roller shade hardware, shade fabric, PoE motor hub, DC shade motor, software and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.

H. Turn-Key Single-Source Responsibility for Wiring Motorized Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the general contractor ("GC"), not roller shade installer/dealer (Window Coverings Subcontractor or "WC"), in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:
   1. GC shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
   2. GC shall coordinate with requirements of WC, before inaccessible areas are constructed.
   3. GC shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by WC.
   4. GC shall provide and run all line voltage (from the terminating points) to the motor controllers. WC shall wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit (provided by Electrical Subcontractor), as required by the electrical code having jurisdiction.
   5. GC shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.
   6. GC shall provide wiring and labor cost difference between power requirements for AC and DC motor options in overall cost comparison of AC and DC motorized shades.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.

B. Store and handle products per manufacturer's recommendations.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent specified in other sections.
   1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer's limits.

1.9 WARRANTY

A. Roller Shade Hardware Warranty: Manufacturer's standard non-depreciating, transferrable warranty for interior shading.
   1. Shade Hardware - 10 years unless otherwise indicated:
      a. ElectroShade with ThermoVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25-years.
   2. All Mecho Shadecloth: Manufacturer's standard 25-year warranty.
   3. Roller Shade Motors, Motor Control Systems, and Accessories: Manufacturer's standard non-depreciating 10-year warranty for AC motors and controls and 10-year warranty for DC motors, power panels and controls. Roller shade low voltage PoE motor and associated wall controller, IDF, plenum located PoE hubs and associated control systems must have manufacturer’s minimum, non-depreciating 10-year warranty. Somfy motors and controls standard 5-year warranty. NuLEDs SpiceBox, keypads, sensors and associated lighting products standard 5-year warranty.
   4. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer for Window Shade Control System as basis of design, performance and warranty: Mecho, which is located at: 42-03 35th St.; Long Island City, NY 11101; ASD Tel: 718-729-2020; Fax: 718-729-2941; Email: marketing@mechoshade.com; Web: www.mechoshade.com. For your local Mecho rep: https://www.mechoshade.com/find-a-rep/ OR architect approved equal.

2.2 APPLICATIONS/SCOPE

A. Roller Shade Schedule:
   1. Shade Type 1: Motor operating sunscreen single roller shades and related motor control systems, mounting systems and accessories as indicated on drawings at the light monitor and the conference room 134..
   2. ADA Compliance: for ADA compliance, Shade Type 1 is to be motorized with an accessible wall switch.

2.3 ROLLER SHADES, MOTORIZED OPERATION AND ACCESSORIES

A. Shade System; General:
   1. Motorized Shades: Comply with NFPA 70.

2. Components capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
3. Operates smoothly when raising or lowering shades.
4. Electrical Components: Listed, classified, and labeled as suitable for intended purpose. Test as total system. Individual component testing is acceptable.
    a. Components: FCC compliant where applicable.

B. Basis of Design: ElectroShade with WhisperShade IQ2 EDU. As manufactured by MechoShade Systems LLC. Motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
1. Description: Single roller.
2. Drop Position: Regular roll.
3. Size: As indicated on drawings.
4. Fabric: As indicated under Shade Fabric article.
5. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight. Basis of Design for details was Electro/3 Bracket.
    a. Material: Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.
    b. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
    c. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).
    d. All bands within a single motor group shall be aligned within ¼ inch.
    e. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single motor.
    f. Radiused Center Support Brackets: Provide brackets and connectors for radiused window applications.
        1) Maximum Offset: 22.5 degrees on each side for a 45 degree total offset.
        2) Maximum Offset: 8 degrees on each side for a 16 degree total offset.
6. Roller Tubes:
    a. Material: Extruded aluminum.
    b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
7. 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.

8. Accessories:
   a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
      1) Finish: Clear anodized.
      2) Capable of installation across two or more shade bands in one piece.
      3) Configuration: Captured and continuous, as indicated on drawings.
   b. Room-Darkening Channels, Standard: Extruded aluminum side and center channels with brush pile edge seals, SnapLoc mounting base, and concealed fasteners. Channels to accept one-piece exposed blackout hembar to assure side light control and sill light control.
   c. Snap Lock Fascia Closure: 2 piece SnapLoc closure consistening of "single closure mount" and 3" removable closure.
   d. Wall Mount Angle: 4" x 4" x 3/16", clear anodized

2.4 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

A. Electronic Drive Unit (EDU) System General Requirements:
   1. A UL 325 listed solution.
      a. Component certification in lieu of system testing is not acceptable.
   2. Listing Label and Motor Rating: To be visible for inspection without dismounting of shade assembly to remove motor or EDU from shade roller tube.
   3. Size and Configuration: As recommended by manufacturer for type, size, and arrangement of shades.
   4. Conceal EDU inside shade roller tube.
   5. EDU Rated Speed: The same nominal speed for shades in the same room.
   6. Hanging Weight of Shade Band: 80 percent of rated lifting capacity of shade EDU and tube assembly.
   7. Capable of upgrading firmware from anywhere on network without touching the motor.

B. Line Voltage EDU (120 VAC):
   1. Basis of Design: MechoShade Systems LLC; WhisperShadeIQ2 System. Tubular, asynchronous, integral AC motor and reversible capacitor. 120 VAC, single phase, 60 Hz; temperature Class B, thermally-protected, totally enclosed, maintenance-free. Powered by line voltage power supply connection equipped with locking disconnect plug assembly furnished with EDU.
   2. Audible Noise: 46 dBA measured 3 ft (914 mm) from motor unit, depending on motor torque.
   3. Nominal Speed: 34 RPM. Not to vary due to load/lift capacity.
   4. Isolated, low voltage power supply for powering external accessories connected to either the dry contact or network port.
      a. Products requiring accessories to be powered by a plug-in or externally-supplied power supply are not acceptable.

C. Low Voltage EDU (24 VDC):

1. Basis of Design: MechoShade Systems LLC; WhisperShade IQ2-DC System. Tubular, asynchronous, integral DC motor. 24 VDC; temperature Class B, thermally-protected, totally enclosed, maintenance-free. Powered by low voltage power supply connection equipped with disconnect plug assembly furnished with EDU.
2. Audible Noise: 38 dBA measured 3 ft (914 mm) from motor unit, depending on motor torque.
3. Nominal Speed: 10 to 28 RPM. Configurable. Speed managed such that it does not vary due to load/lift capacity.
4. Low voltage power supply for powering external accessories connected to either the dry contact or network port.
    a. Products that require accessories to be powered by a plug-in or externally-supplied power supply are not acceptable.
5. Wireless Controls: Optional built-in two-way wireless EnOcean controls through iQ3-DC-RF motor.
6. Override Mode: Place motor into Override Mode when local switch commands shade to new position.
    a. Local switch command sources:
        1) Keypad connected to EDU dry contact inputs.
        2) Third-party system connected to EDU dry contact inputs.
        3) Network keypad or other device that serially communicates with EDU and configured to issue override commands as if it were a local switch connected to EDU dry contact inputs.
    b. Entering Override Mode: Monitor and log positioning commands from automation devices. Do not act until exiting Override Mode.
    c. Return from Override Mode: Position shade to last commanded position in log.
    d. Automated Return from Override Mode:
        1) Override Return Timer: When Override Mode is entered by changing shade position with local switch as described above, Enable override return timer to make these changes temporary such that automation can regain control of shade after configurable time duration (default of 60 minutes).
        2) Pocket temperature sensor integral to EDU to track pocket temperature.
            a) When shade is in Override Mode and Heat Gain Sensing is Enabled: Sensor determines when direct sunlight and associated solar heat gain has left the window.
                1) When this condition occurs, after the shade has been overridden to cover the window, EDU to return from Override Mode if Override Return Timer has not done so already in order for automation controllers to once again optimize shade position for exposure to daylight.
7. Preventative Maintenance:
    a. Internally monitor important operating parameters to ensure motor and its shade assembly are functioning properly.
    b. Performance Degradation: Provide visual indication via feedback LED and communicate warnings on repetitive basis through its serial port.
    c. Warning Conditions: Logged and queryable. Allow sending of multiple warnings until condition is acknowledged.

d. Stop shade rotation for parameters of critical concern until reset by trained technician after being serviced.
e. Devices capable of receiving warnings include SolarTrac automated solar-evaluation control system.
f. Tracked Parameters to include:
    1) Operating life (cycles, hours).
    2) Pocket temperature.
    3) Internal motor temperature.
    4) Vibration.
    5) Stall.
    6) Power reset.
    7) Maintenance Mode.
    8) Speed regulation.
    9) Position targeting.
    10) Movement without command.
    11) One Bus availability.
g. Detectable Potential Warning Conditions to Include:
    1) Assembly vibration/bearing wear warning.
    2) Tube/shade assembly drop.
    3) Fabric hung-up/telescoping.
    4) Motor mount warning.
    5) Lifecycle replacement warning.
    6) Brake/limit failure.
    7) Network warning.
    8) Motor internal temperature warning.
    9) Pocket temperature warning.

D. Low Voltage EDU by Mecho to operate on Power Over Ethernet (PoE).
1. Intelligent motors controlled and monitored via IP digital network
2. IP Gateway must be supplied to work with overall control system
3. All power delivered to motor directly from UPoE+ switch with minimum of 90 watt output on every port (switch supplied and supported by others)
4. UPoE+ (90W) Shade Controller and MechoNet Hub • Supports IEEE 802.3af, 802.3at, 802.3bt Type 3 or Type 4 PoE Network Switches with LLDP. (PoE, PoE+, UPoE, UPoE+ compliant.
5. PoE port power ratios by supporting simultaneous group control of multiple IQ2-DC motors over 1 PoE hub.
6. Single network solution across the building for windows of all sizes using both AC and DC motorized shades. PoE Hub controls unlimited line voltage AC-powered WhisperShade IQ2 and IQ2+ motorized shades.
7. PoE Hub provides access to MechoNet Wireless sensors and keypads through MechoNet MWC+ controllers.
8. Cisco DNA / Smart Building Solutions Partner - Employs CoAP (Constrained Application Protocol) messaging and MUD (Manufacturer Usage Description) for secure, open communication across sub-systems.
9. SolarTrac 4.0 compliant for industry leading automation strategy efficacy and flexibile

10. DC motor according to standards ISO3741 NF 31022 in dBA ref 1pW at nominal Torque without end product < 38 dBA
11. Maximum current draw for each shade LV DC Motor of 1.5 Amps at 24VDC.
12. PoE LV DC motor rated speed is 10-25rpm Adjustable
13. Temperature Working Range 32°F to 140°F (0°C to 60°C) (Interior use only)
14. Insulation Class: Class 111
15. Wiring to be all low voltage cat6 to IP Hub from UPoE switch
16. Index Protection Rating: IP 20 (interior)
17. UL Listed FCC and CE compliant

E. PoE LV DC Motor System: (software, two-way communication): Specifications and design are based on Intelligent PoE motor control system from Mecho. PoE performance criteria:
   1. PoE LV DC Motor shall support two methods of control
      a. Local override wall control for in room manipulation
         1) Controller to work on COAP protocol
         2) User interface via GUI to manage controllers to shades
      b. Network Control
         1) PoE Motor shall be equipped with a bi-directional IP network communication capability to support operation of individual or groups of shades over a common IP network via an API.
   2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into PoE LV DC motors using either a handheld removable program module or MechoNet Programming software.
   3. Alignment Positions: Each PoE LV DC motor shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
      a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
      b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
      c. Alignment of shades mechanically aligned on the same PoE LV DC motor shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
      d. Alignment of shades on adjacent PoE LV DC motors shall not exceed +/- 0.25” inches (6.35mm) when commanded to the same alignment position.
      e. Local on wall controller:
         1) Upon setting the limits for the shade, PoE LV DC motor preset positions shall be capable of IP control to default to 25%, 50% and 75% of the shade travel in addition to standard up and down
         2) These positions shall be capable of being customized.
      f. Network Presets: A minimum of 10 customizable preset positions shall be accessible via network commands.
         1) Upon setting the limits PoE LV DC motor these preset positions shall automatically default to the lower limit unless customized elsewhere.
         2) These positions shall be capable of being customized and grouped using the control software.

4. PoE LV DC Motor Wiring
    a. One unshielded Twisted CAT-6 or higher from every motor hub location to floor IDF / IT room or as per wiring diagram to plenum rated Cisco switch in zone.
    b. Each wire to meet TIA-568B Standard with Plastic RJ-45 Connectors
    c. Wire to be plenum rated where required by code
    d. Every wire to be machine labeled at each end with a unique identifier.
    e. LV DC Shade motor end to have 12" whip rolled up to allow for shade installation
    f. Closet end to be punched down into patch panel (rack location and style to be coordinated in field by GC or end user)
    g. Every wire to be certified using Fluke DSX cable analyzer or comparable equipment.
    h. Max Distance from Switch to PoE Motor Hub is 225' with 2x14AWG/3x22AWG cable.

F. Modes of Operation:
1. Uniform Mode: Shades move to defined intermediate stop positions in order to maintain aesthetic uniformity.
2. Normal Mode: Shades move to defined intermediate stop positions and any position between defined upper and lower limits.
3. Maintenance Mode: Prevents shade from moving via dry contact or network control commands mode has been cleared/disabled.

G. Control Methods: Local isolated dry contact input and network control.
1. Local Isolated Dry Contact Inputs:
    a. Local switch control, third party system integration without separate interface.
    b. Moving EDU/shade to upper and lower limits and local switch preset positions.
    c. Configuration of upper and lower limits, custom presets, and key modes of operation without a PC or microprocessor-based tools.
    d. Configuration under protected sequences to prevent changes by casual user.
    e. Switch Personalities: Configuration of dry contact control port over network such that any type of dry contact keypad/third-party interface and actuation methodology (maintained and/or momentary actuation) can be used to operate shade.
    f. Dry Contact Control Connection Options to Include:
        1) One-button.
        2) Two-button.
        3) Three-button. Able to support configuring limits, presets, and key operating modes (default).
        4) Three-button. No configuration capability to prevent accidental changes in settings.
2. Network Control:
    a. Bi-directional network communication to enable commanding operation of large groups of shades over a common backbone.
    b. Each EDU:
        1) Support eight network addresses capable of being employed for various levels of group control.

2) Dry Contact Ports: Assigned its own local switch address which can be matched by other EDUs within eight network addresses in order to support group control when dry contact commands are received.
a) The EDU receiving dry contact commands may or may not be configured to operate based on commands coming through its own dry contact input port.
3) To have an independent unique identifier address (UID) enabling EDU to be independently controlled and configured over network via handheld configurator and/or PC controller.

c. Network Communication Card: Integral with tubular EDU assembly.
d. Support configuration of upper and lower limits using either a handheld removable program module/configurator or a local switch.
e. Support configuration of addresses using a handheld removable program module/configurator.

H. Alignment Positions:
1. Repeatable and precisely aligned shade positions and limits.
a. Support positioning commands from 0 to 100 percent in 1 percent increments.
b. Customizable Presets: 32.
c. Include three intermediate dry contact presets
2. Shades on same switch circuit or same network group address with same opening height, to align at each intermediate stopping position when traveling from any position, up or down.
3. Shades of differing heights: Capable of custom, aligned intermediate stop positions when traveling from any position, up or down.
4. Alignment of shade bands mechanically aligned on same EDU: Plus or minus 0.125 inch (3 mm).
5. Alignment of standard shades on adjacent EDUs: Plus or minus 0.25 inch (6 mm) when commanded to same alignment position.

I. Local Switch Presets:
1. Minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
2. Preset positions: Customizable to any position between and including defined upper and lower limits (initially defaults to 25, 50, and 75 percent of shade travel).
3. Configuration of Custom Preset Positions: A handheld removable program module/configurator or a local switch.

J. Network Presets:
1. Minimum of 32 customizable preset positions (including the three local switch presets) accessible via network commands.
2. Preset positions: Customizable to any position between and including defined upper and lower limits (initially defaults to defined lower limit).
3. Configuration of Custom Preset Positions: A handheld removable program module/configurator or a local switch.

2.5 MOTOR CONTROLS, INTERFACES, AND ACCESSORIES

A. Unless indicated to be excluded, provide required equipment as necessary for a complete operating system providing the control intent specified. Provide components and connections necessary to interface with other systems as indicated.

B. Digital Network Controls:
   1. Basis of Design: MechoShade Systems LLC; MechoNet. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet (1,219 m), 250 nodes.
   2. Reprogram control without requiring wiring modifications.
   3. Ten-year non-volatile power failure memory for system configuration settings.
   4. Network Interface Components:
      a. MechoNet Network Interface; MNI Series: Four configurable motor/EDU ports (models available for RJ45 or terminal block wiring); four configurable switch ports; one infrared (IR) remote control port; one configurable serial port for RS232/RS485 communication.
      b. IQ2 Dual Splitter: Two motor/EDU ports; two switch ports.
      c. IQ/MLC2 Motor Group Controller: Four ports for line-voltage standard (non-intelligent) motors (120 or 230 VAC; 600 W, 1/4 HP maximum).
      d. IQ Gateway; one for each floor where controlling across multiple floors.

C. Low-Voltage Wall Controls; IQ Switch:
   1. Momentary dry contact switch enables manual local control or network control of any individual shade motor or shade group/sub-group on MechoNet network.
   2. Control Functions:
      a. Open: Automatically open controlled shades to fully open position when button is pressed.
      b. Close: Automatically close controlled shades to fully closed position when button is pressed.
      c. Presets: For selection of predetermined shade positions.
      d. Dual Stations: For individual control of two shades/groups.
   3. Finish: White.
   4. Single Station: 5-button (open, close, and three intermediate stop positions).
   5. Double Station: 10-button (open, close, and three intermediate stop positions for each of two shades/groups).

D. Wireless Controls:
   1. MechoNet Wireless Controllers:
      a. Serves as gateway, router, and controller between EnOcean wireless devices and MechoNet network.
      b. Communicates with EnOcean wireless devices via 902 MHz RF. Supports wireless daylight sensors, occupancy/vacancy sensors, and switches.
      c. Controller to manage up to 16 EnOcean wireless devices.
      d. Controller to be configurable to one of two modes of operation:
         1) SolarTrac Mode: Relays EnOcean wireless sensor and control information to SolarTrac automatic solar-evaluation control system.
         2) Solar Activated Control Mode: Utilizes EnOcean wireless sensor and control information for internal automation algorithms to adjust shade positions.

a) Adjusts shade positions based daylight sensors input optimizing visual comfort. Enables five shade positions; full-up, full-down, and three configurable intermediate preset stop positions. Default of three positions; full-up, full-down, and preset number two.
b) Configurable daylight thresholds for shade positions. Includes configurable hysteresis setting, default of 20 percent, preventing frequent cycling of shades during fluctuating daylight conditions.
c) Configurable delay timers inhibit shade position changes due to short duration changes in daylight conditions. Default of 300 seconds delay for up, 60 seconds delay for down.
d) Night Mode: Configurable night time shade position to support light pollution, privacy, and/or energy conservation requirements. Configurable daylight threshold. Default of 18.6 footcandles (200 lux), Duration: Default of 60 minutes to enter night mode, 30 minutes to exit night mode.
e) Occupancy/Vacancy: Where wireless occupancy/vacancy sensors are specified, enables configurable unoccupied/vacant mode shade position (default of full-down) to optimize energy conservation. Configurable timers for detection of unoccupied and occupied states.
f) Manual Override: Where local switches are specified. Enables manual temporary override of shade positions for configurable duration. Default of 60 minutes.
g) Retract Mode: Manages changes to light level based on shade position for comfort and increasing exposure of occupant to daylight. Shades move up in stepped one-position increments as daylight levels drop. Each step is maintained for one minute while controller retests daylight conditions before authorizing the next step until target is reached.

e. Capable of being powered by a dedicated low-voltage power supply or through certain MechoNet devices without additional power supplies.
f. Multiple sensors to be configurable to automate the same shade control zone in order to ensure operation based on worst case comfort conditions across the zone.
g. Sensors to be configuralbe to automate multiple shade control zones.
h. Maintain a circular log of previous 48 hours of data received from each of 16 possible wireless devices. Data to be capable of being downloaded and stored for record keeping, performance optimization, or troubleshooting purposes.
i. Wireless Daylight Sensor (SolarTrac Room) Ready when using PoE Motors.
1) EnOcean® 2-way RF transceiver sensor monitors the daylight level and thermal conditions at curtain wall and relays information to IP PoE network using EnOcean and COAP protocols. Controller logs and associated data must support analytics and allow for feed information over to Mecho SolarTrac software for whole building automation or be configured to operate shades directly based on local conditions from sensors.

2) Mecho Wireless Controller when deployed on an IP PoE network can also receive data and/or commands from other EnOcean devices such as battery less keypads, occupancy sensors, magnetic door and window sensors, lighting controllers, thermostats, etc. Up to 20 wireless EnOcean sensors and/or devices can be hosted by each controller enhancing local operation without adding any cables.

2. Wireless Daylight Sensors (SolarTrac "ROOM"):
   a. Monitors daylight through curtainwall and communicates with MechoNet Wireless Controller. Adjusts shade position based on user-defined light thresholds.
   b. Powered by integral photovoltaic cells. No batteries or external power supplies.
   c. Data Transmission:
      1) Provide the following data with each message:
         a) Charge level.
         b) Illuminance: 0 to 6,100 foot-candles (0 to 65,656 lux). Plus or minus 5 percent accuracy.
      2) Transmit message when daylight level changes by three percent.
      3) Transmit "heartbeat" message once per minute during daylight and once per hour at night for determining when maintenance/support is required.
   d. Mountable horizontally, vertically, and upside-down on mullion without screws.
3. Wireless Occupancy Sensors:
   a. Monitor room/area occupancy. Communicate with MechoNet Wireless Controller optimizing shade positions.
   b. Solar-powered with battery backup.
   c. Passive infrared (PIR) sensing.
   d. Ceiling-mounted with 360 degree angle of detection optimized for ceiling height between 8 and 10 feet (2.4 and 3.0 m).
4. Wireless Switches:
   a. Communicates with MechoNet Wireless Controller. Adjusts shade positions based on switch operation.
   b. Enables manual local control or network control of any individual shade motor or shade group/sub-group on MechoNet network.
   c. Self-powered via rocker switch operation.
   d. Finish: White.
5. MechoNet Wireless 0-10v Interface:
   a. Translates the 0-10V command to ElectroShade iQ3-DC-RF motors via EnOcean protocol and lets the dimming value (8-bit) data control shade positions with presets or percentage options.
      1) The default preset levels are 25%, 50%, 75% and full up/down based on the output of the 0-10V Interface or 0-10V Dimmer.
      2) The position levels can also be configured by percentage with a 10% increment based on the output of the 0-10V Interface. The positions can be customized to set 0V and 10V as Full Up or Full Down.
   b. Individual and group motor control based on EnOcean channels or MechoNet addressing.

c. Wireless EnOcean Communication.
d. Two inout channels supporting 0-10VDC.
e. Voltage pull-up's available on the inputs for dry contact applications.
f. DIN Rail Mount (DIN Rail not included).
g. Cage-clamp style terminal blocks for all wiring connections.
h. LED interface for channel status indication.
i. Available in 902 MHz.
j. Internal and optional external antennae.

E. MechoNet User App Kit – App-Based Motor Control Accessory
1. Description**:** Provide and install the MechoNet™ User App Kit for app-based control of Mecho ElectroShade® iQ™ motorized shading systems. This kit shall integrate MechoNet+ motors into a unified control platform utilizing the Bond Bridge Pro and MechoNet™ Motor Hub.
2. Components**:**
a. Bond Bridge Pro Wi-Fi/Ethernet device
b. MechoNet™ Motor Hub with Ethernet-to-MechoNet+ routing
c. MechoNet+ Terminator and RJ45 T-Connector
d. Low-voltage MechoNet+ cables (24" and 30"
e. Optional Sidekick remote for additional wireless control
3. Functional Requirements:
a. Provide app-based setup and configuration using the Bond Home app on iOS or Android.
b. Enable control of up to 50 MechoNet+ motors per kit (multiple kits required for larger groups).
c. Support scheduling (including astronomical), preset positions, scene-based control, and group shade movement.
d. Enable seamless communication via secure protocols for integration with building control systems.
e. Include LED indicators for real-time status and installation feedback.
f. Provide support for ElectroShade® iQ2+, iQ2-DC, iQ3-DC, and iQ3-DC-RF motors.
g. Mounting hardware to support wall, ceiling, or backing board installations as required.
4. Connectivity Requirements:
a. Bond Bridge Pro must connect to a 2.4 GHz Wi-Fi network.
b. Device and smartphone must be on the same network during setup.
c. Not compatible with WPA-Enterprise or captive portal networks.
d. Confirm SSID and network readiness with client prior to installation.
5. Notes:
a. Kit must comply with UL4200A safety standards.
b. Handle components using proper electrostatic discharge (ESD) precautions.
c. Installer to coordinate motor addressing and app configuration using MPS prior to commissioning.

F. Automatic Solar-Evaluation Control System:
1. Basis of Design: MechoShade Systems LLC; SolarTrac "BUILDING". Utilizes ASHRAE Clear Sky algorithms to incrementally adjust shade positions maximizing

energy management, daylighting, occupant view, and occupant comfort. Sky model calculated on a daily basis.

2. System Capacity: Supports 65,000 zones/65,000 motors.
3. Platform: Windows Service. Supports Windows PC, Windows Server, and Windows Virtual Machine.
4. Communications Riser/Backbone: Manufacturer-approved communications riser/backbone and switches for communication at floor/areas. Support dedicated Ethernet network, building/BMS Ethernet network, and RS485 riser/backbone implementation.
5. Algorithms: Calculate the following on a continuous basis; once every five seconds, 24 hours per day, 365 days per year, for each window.
    a. Solar Heat Gain: Btu/hour/sq foot (W/sq m) multiple times per minute.
    b. Incident angle.
    c. Profile angle.
    d. Direct radiation.
    e. Diffuse radiation.
    f. Surface azimuth.
    g. Solar surface azimuth.
    h. Algorithms to include consideration of:
        1) Window geometry/profile, including window overhangs.
        2) Allowable solar depth of penetration.
        3) Sky condition (e.g. clear, cloudy, overcast), as determined by algorithms model based on input from roof-mounted solar radiometers.
6. Internet Weather: Supports Internet weather coupled with wireless daylight sensors for determination of sky conditions where roof-mounted solar radiometers cannot be used.
7. Shade Positioning:
    a. Align shades up to 256 positions.
    b. Calculate positioning resolution once every minute.
    c. Stagger operation of shade motors for electrical load balancing.
8. Override Capability:
    a. Automatic Override of Shade Positions for the Following:
        1) Cloudy Sky Conditions: Based on input from roof-mounted solar radiometers. Shades go to predetermined position maximizing occupant view and available daylight.
        2) Bright Conditions: Based on input from wireless daylight sensors and user-defined allowable brightness ratio. Requires Brightness Override Module. Shades go to predetermined position to maximize occupant comfort.
        3) Dark Conditions: Based on input from wireless daylight sensors. Requires Darkness Override Module. Shades go to predetermined position to maximize occupant view and available daylight.
        4) Facades and Zones: In shadow due to adjacent structures (e.g. buildings, trees, etc) as determined by three-dimensional model and user-defined timing parameters; requires Shadow Override Module option; shades to go to predetermined position to maximize occupant view and available daylight.

5) Reflections from adjacent structures or features (e.g. buildings, bodies of water, etc.) as determined by three-dimensional model; requires Reflection Module option; shades to go to predetermined position to maximize occupant comfort.
6) Event scheduler, configurable via browser user interface; enables override of individual shade motors, shade zones, and floors based on date range, day of week, absolute time range, and sunrise/sunset relative time range with capability of dependency on sky conditions.
7) Occupancy/vacancy, based on input from wireless occupancy/vacancy sensors (where specified); shades to go to configurable unoccupied/vacant mode shade position (default of full-down) optimize energy conservation; provide configurable timers for detection of both unoccupied and occupied states.

b. Manual temporary override of shade positions:
1) IQ Switch low-voltage wall controls or touchscreen manual override panels.
2) Browser Interface: Enables control of individual shade motors, shade groups, or zones. Administrative settings allow for assignment of shade control restrictions for specific users.

c. Configurable resumption of automatic control following manual temporary override event based on wake, sunrise, sunset, sleep, time duration, and specific times.

9. Data Logging:
a. Periodic: Roof-mounted solar radiometer and wireless daylight sensor data, Internet weather. Store at rate of once per minute.
b. On Change: Shade position, shade status, overrides, alerts/errors, sky conditions, user login/logout, setting/configuration changes, remote access commands/overrides (e.g. BMS, A/V, etc).

10. Browser-Based Graphic User Interface (GUI):
a. Interactive Floor Plan: Graphical map of each floor for setup, monitoring, and control. Pan and zoom navigation.
b. Access to adjustable parameters and displays current values including but not limited to:
1) Radiation.
2) Shade position.
3) User-defined requirements.

c. Display current sky conditions based on input from roof-mounted solar radiometers.
d. Zone/Sensor Monitoring: Display current operation of selected zones or sensors.
e. Manual/Master Override:
1) Interactive Floor Plan: Graphical map of each floor showing shade groups, zones, and sensors with current position of each zone.
2) Universal Command View: Enables whole floor/building control.

f. Alerts/Notifications:

1) Display real time event notification including gateway or motor not responding, motor in wrong position, motor overridden, and zone overridden.
2) Display manual overrides from touchscreen manual override panels. Bbrowser and remote/third party interface (BMS, A/V, etc).
3) Configurable for email alerts and notifications.

g. Reports/Analysis:
1) Data Storage/Event Log: Continuous daily activities record.
2) Current Day's Activity: Visual record of zone operations by intermediate stop locations.
3) Trending Reports:
a) Daily: Includes sky, sensors, event log, and timeline.
b) Shade Position: Percentage of time shade spent at each position.
c) Override: Reason for override and percentage of day shade spent overridden up/down.
4) Zone history analysis.

h. Multi-level user access. 1,000 user accounts, with 100 simultaneous users. Utilize security certificates.

11. Configurable Zone Properties:
a. Minimum move timer: For restricting frequent shade movement.
b. Wake and sleep time and position.
c. Window geometry (overhangs, fins, sill height).
d. Profile angle; minimum and maximum.
e. Auto position; minimum and maximum.
f. Night position.
g. Cloud position.
h. Position and threshold for overcast.
i. Bright overcast.
j. Bright clear.
k. Bright cloudy.
l. Darkness sky conditions.
m. Sunset/sunrise offset and position.
n. Allowable solar penetration; maximum.
o. Solar heat gain; minimum.
p. Solar heat gain thresholds per preset position.
q. Number of preset positions.
r. Multi-tier zone settings (number of tiers or window heights).
s. Tandem mode zones.
t. Retract mode enable/disable.
u. Sensor bindings (which sensors affect selected zone).

12. Integration with Other Systems: Support third party systems including building management systems (BMS), lighting control systems, audio-visual (A/V) systems, HVAC control systems, and energy dashboards via BACnet (BTL certified), Ethernet UDP, Ethernet TCP/IP, REST API, and RS485.
13. Campus Support: Management of multiple buildings through single user interface.
14. Accessories:

a. Solar Radiometers: Rooftop measurement of sky conditions. Quantity of three unless otherwise indicated.
b. Sunrise/Sunset Sensors: Supplementing solar radiometers. Accurate measurement of sky conditions during sunrise/sunset periods.
c. MechoNet Wireless Daylight Sensors: As specified for automatic override of shade positions for bright conditions. Communicates wirelessly to MechoNet Wireless Controller configured for SolarTrac mode.
d. MechoNet Wireless Occupancy Sensors: As specified for automatic override of shade positions based on occupancy status. Communicates wirelessly to MechoNet Wireless Controller configured for SolarTrac mode.
e. Touchscreen Manual Override Panels: Manual temporary override of shade positions. Enables manual control of shades via touchscreen interface with graphical map of shades for local area.
f. Low-Voltage Wall Controls; IQ Switch: As specified for manual temporary override of shade positions.

G. Automatic Solar-Tracking Control System:
1. Basis of Design: MechoShade Systems LLC; SunDialer (SolarTrac "FLOOR"); www.mechoshade.com/#sle. Solar evaluation and sky modeling system.
a. Utilize ASHRAE Clear Sky algorithms incrementally adjusting shade positions in order to maximize energy management, daylighting, occupant view, and occupant comfort; sky model calculated on a weekly basis.
2. System Capacity: 24 zones.
3. Communications Riser/Backbone: Manufacturer-approved communications riser/backbone and switches for communication at each floor/area.
a. Support dedicated Ethernet network, building/BMS Ethernet network, and RS485 riser/backbone implementation.
Algorithms Calculating for Each Window: Weekly basis (52 model days per year).
b. Solar heat gain. Btu/hour/sq foot (W/sq m) multiple times per min.
c. Incident angle.
d. Profile angle.
e. Direct radiation.
f. Diffuse radiation.
g. Surface azimuth.
h. Solar surface azimuth.
4. Algorithms to include consideration of:
a. Window geometry/profile, including window overhangs.
b. Allowable solar depth of penetration.
c. Sky condition (e.g. clear, cloudy, overcast), as determined by microclimatic model based on input from roof-mounted solar radiometers.
5. Shade Positioning: Aligning shades to 256 positions.
a. Calculate shade positioning resolution once every minute.
6. Override Capability:
a. Automatic override of shade positions:
1) Dark (cloudy) sky conditions, based on input from roof-mounted solar radiometers.

a) Shades go to predetermined position maximizing occupant view and available daylight.

2) Event scheduler: Configurable via control software. Enables override of shade zones based on date range or absolute time range.

b. Manual override of shade positions using:

1) IQ Switch low-voltage wall controls. Software user interface.

a) Requires one SunDialer IP Interface unit per system.

2) VirtualSwitch Override: Browser user interface over local area network.

a) Enables control of individual shade motors, groups, or zones.

b) Administrative settings allowing assignment of shade control restrictions for specific users.

7. Data Logging:
   a. Periodic: Roof-mounted solar radiometer data. Storage Rate: once per minute.
   b. On Change: Shade position, overrides, sky conditions.
8. Integration with Other Systems: Third party systems including building management systems (BMS), lighting control systems, audio-visual (A/V) systems, HVAC control systems, and energy dashboards via Ethernet TCP/IP and RS485.
9. Configurable Zone Properties:
   a. Wake and sleep time and position.
   b. Window geometry (overhangs, fins, sill height).
   c. Profile angle; minimum and maximum.
   d. Auto position; minimum and maximum.
   e. Night position.
   f. Cloud position.
   g. Sunset/sunrise offset and position.
   h. Allowable solar penetration; maximum.
   i. Solar heat gain; minimum.
   j. Solar heat gain thresholds per preset position.
   k. Number of preset positions.
10. Controller: 12-zones with sensor ports for solar radiometer and IP interface.
    a. One required per project; minimum.
    b. Requires internet connection for remote connectivity.
11. Controller: 12-zone controller without sensor ports.
12. Accessories:
    a. Solar Radiometers: For rooftop measurement of sky conditions. Two required unless otherwise indicated.
    b. Sunrise/Sunset Sensors: Supplemental to rooftop solar radiometers for accurate measurement of sky conditions during sunrise/sunset periods.
    c. Low-Voltage Wall Controls; IQ Switch: As specified for manual temporary override of shade positions.

2.6 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within ¼" tolerances.

C. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

2.7 SHADE FABRIC

A. Basis of Design: Shade fabric as manufactured by MechoShade Systems LLC.
   a. Fabric: Soho: 1900 series. 5 percent open. 2 x 2 basket-weave pattern of fine yarn, PVC and polyester blend
      1) Color: 1905 Dove Grey

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

C. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: Design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified is to be performed by a single manufacturer and their authorized installer/dealer.
   1. The Architect will not provide a set of electrical drawings for installation of control wiring for motors, or motor controllers of motorized roller shades.
   2. General Contractor (GC) To Provide the Following:
      a. Power Panels and Circuits: Size to accommodate roller shade manufacturer's requirements, as indicated on mechanical and electrical drawings.
      b. Coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
      c. Line voltage as dedicated home runs, of sufficient quantity, and capacity as required. Terminate in junction boxes at locations designated by roller shade installer/dealer.
      d. Run line voltage from terminating points to motor controllers. Wire roller shade motors to motor controllers.

1) Above-ceiling and concealed wiring to be plenum-rated, or in conduit, as required by the electrical code having jurisdiction.

e. Use conduit with pull wire in areas, not accessible to roller shade contractor due to building design, equipment location or schedule.

f. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.

g. Comply with manufacturer's current product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

h. Protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.

i. Be responsible for all other required electrical work including but not limited to roof penetrations, conduits, fireproofing, etc.

j. Provide conduit with pull wire in all areas, which might not be accessible to subcontractor due to building design, equipment location or schedule.

3. Window Covering Subcontractor (WC) responsibilities:

a. Shade Control Subcontractor shall furnish, install and fully program shade controllers, interfaces, splitters, coupler, sensors, switches, etc. mounted on the wall, in the ceiling, in shade pocket, etc.. Locations for all visible devices to be coordinated with Architect. The shade control subcontractor shall inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

b. Run low voltage control wiring from motor controllers to switch/control locations designated by Architect.

1) Above-ceiling and concealed wiring to be plenum-rated, or in conduit, as required by the electrical code having jurisdiction.

C. Integration with 3RD Party Systems:

1. Main contractor shall coordinate and provide for others to furnish, install or program any interfaces or wiring to integrate 3rd party systems to the roller shade control system as specified herein. Integration to shade control network can be accomplished locally through IP via UPoE switch with minimum of 60w output per port.

3.4 INSTALLATION

A. Contractor Furnish and Install Responsibilities:

1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.

2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between shade groups, which shall not exceed +/- 0.25" inches (6.35mm).

3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.

4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner

of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.

5. WC shall provide accurate to 0.0625” inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and as specified here in. Blocking for roller shades furnished and installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect’s design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625” (15.875mm) over 20 linear feet (6.096 meters)
7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
11. The WC shall participate and cooperate with the electrical, low voltage and commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.
12. Clean roller shade surfaces after installation, according to manufacturer’s written instructions.
13. WC shall train Owner’s maintenance personnel to adjust, operate and maintain roller shade systems.
    a. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

3.5 PROTECTION AND CLEANING

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.
1. Clean soiled shades and exposed components as recommended by manufacturer.
2. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION 12496

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS & WINDOW SILLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface window sills.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

D. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Corian Solid Surface, Ash Concrete

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front: Straight, slightly eased at top
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

4. Refer to drawings

C. Countertops: 1" thick, solid surface material with 1 1/2" Radius bull nose edge.

D. Joints: Fabricate countertops without joints (if possible).

E. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2. Solid Surface Sinks: Rout sink cutouts to manufacturer's template. Adhere solid surface cast sink units to countertops with adhesive per manufacturer's recommendation.

2.3 WINDOW SILL MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Corian Solid Surface, Dove

2.4 WINDOW SILL FABRICATION

A. Configuration per drawings.

2.5 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 COUNTERTOP INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

F. Install aprons to backing and countertops with adhesive.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

3.2 WINDOW SILL FABRICATION

A. Install window sills for full length of each window unit, securing to substrates with concealed fasteners and specified adhesive.

B. Provide minimum 1/8 inch expansion gap on both sides of window sills. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

C. Completed work to be plumb, level, and true, with edges eased and sanded smooth.

END OF SECTION 123661.16

SECTION 210000 - FIRE PROTECTION SPRINKLER SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Provide a complete and working wet pipe sprinkler system as indicated herein and/or shown on drawings. Provide labor, materials, and perform all operations required and reasonably implied in the provision of the wet pipe sprinkler system. Contractor shall arrange all permits and inspections and pay all associated fees.

B. The Contractor shall design a fire protection sprinkler system based on NFPA requirements for occupancy.

C. Contractor shall be responsible for provision of all other phases in the contract documents such as mechanical, structural, electrical and architectural systems and shall design to facilitate all features of the building while complying with NFPA.

D. Any conflict between the governing authority and the plans and specifications shall be called to the attention of the Engineer.

E. Coordinate closely with fire alarm and electrical power systems for special use areas such as elevators and electrical equipment rooms.

1.02 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Piping materials, including dielectric fittings and flexible connections and sprinkler specialty fittings.

2. Pipe hangers and supports.

3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.

4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

5. Monitors.

6. Alarm devices, including electrical data.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

D. Field Test Reports and Certificates: 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" and "Contractor's Material and Test Certificate for Underground Piping."

E. Welding certificates.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Installer Qualifications and Responsibilities:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

2. NFPA 14, "Standpipe and Hose Systems."

1.05 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, 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 on Project.

PART 2 PRODUCTS

2.01 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.

1. Malleable-Iron Threaded Fittings: ASME B16.3.

2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.

3. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.

2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Threaded-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-threaded ends.

1. Malleable-Iron Threaded Fittings: ASME B16.3.

2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.

3. Steel Threaded Couplings: ASTM A 865.

D. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.

2. Steel Flanges and Flanged Fittings: ASME B16.5.

E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.

1. Malleable-Iron Threaded Fittings: ASME B16.3.

2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or

ASTM A 106, Schedule 40, seamless steel pipe.

3. Steel Threaded Couplings: ASTM A 865.

F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.

2. Steel Flanges and Flanged Fittings: ASME B16.5.

G. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.

H. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.

1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, pre-lubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.02 DIELECTRIC FITTINGS

A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.

D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.

E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.

F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.

2.03 FLEXIBLE CONNECTORS

A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: Threaded.

2. NPS 2-1/2 and Larger: Flanged.

B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.04 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

D. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.05 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, non-rising stem, operating nut, and flanged ends.

2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.

2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends

D. Butterfly Valves: UL 1091.

1. NPS 2 and Smaller: Bronze body with threaded ends.

2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged ends.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged ends.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.

2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged ends.

2.06 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.07 SPECIALTY VALVES

A. Pressure-Regulating Valves: UL 1468, brass or bronze, NPS 1-1/2 and NPS 2-1/2, 400-psig minimum rating. Include female NPS inlet and out, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated. Finish: Rough metal.

B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

2.08 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 1626, for residential applications.

2. UL 1767, for early-suppression, fast-response applications.

C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

1. Open Sprinklers: UL 199, without heat-responsive element.

a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

D. Sprinkler Finishes: Chrome plated, bronze, and painted.

E. Special Coatings: Wax, lead, and corrosion-resistant paint.

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.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.

2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.04 JOINT CONSTRUCTION

A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

B. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.

2. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.05 INTERIOR PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

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.

B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

C. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

D. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

E. Install sprinkler piping with drains for complete system drainage.

F. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

G. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install sprinkler system piping according to NFPA 13.

H. Fill wet-pipe sprinkler system piping with water.

I. Install alarm devices in piping systems.

3.06 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty 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.

3.07 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.08 MONITOR INSTALLATION

A. Install monitor bases securely attached to building substrate.

3.09 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Electrical Connections: Power wiring is specified in Division 16 (22).

C. Connect alarm devices to fire alarm.

D. Ground equipment according to Division 22 Section "Grounding and Bonding."

E. Connect wiring according to Division 22 Section "Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 23 Section "Mechanical Identification."

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system 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. Energize circuits to electrical equipment and devices.

4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

5. Coordinate with fire alarm tests. Operate as required.

6. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.12 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION

SECTION 21 05 00 -- FIRE PROTECTION: COMMON WORK RESULTS

PART 1 - GENERAL

1.01. SCOPE

A. This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL
Scope
Related Work
Reference
Standards
Quality Assurance
Protection of Finished Surfaces
Sleeves and Openings
Sealing and Fire Stopping
Off Site Storage
Codes
Design Criteria
Certificates, Inspections, and Permits
Submittals
Operating and Maintenance Instructions
Training of Owner Personnel
Record Drawings
Electronic Media
Warranty

PART 2 - PRODUCTS
Access Panels and Doors
Identification
Sealing and Fire Stopping

PART 3 - EXECUTION
Concrete Work
Cutting and Patching
Building Access
Equipment Access
Coordination
Identification
Lubrication
Sleeves
Sealing and Fire Stopping

1.02. RELATED WORK

A. This Section applies to all Division 21 Sections of Fire Suppression.

1.03. REFERENCE

A. Applicable provisions of Division 00 and 01 govern work under this section.

1.04. STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:
- AGA American Gas Association
- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- ASPE American society of Plumbing Engineers
- ASTM American Society for Testing and Materials
- AWWA American Water Works Association
- AWS American Welding Society
- CGA Compressed Gas Association
- CS Commercial Standards, Products Standards Sections, Office of Engineering Standards Service, NBS
- EPA Environmental Protection Agency
- FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
- IAPMO International Association of Plumbing & Mechanical Officials
- IEEE Institute of Electrical and Electronics Engineers
- ISA Instrument Society of America
- ILHR/State of Minnesota Building Code
- MCA Mechanical Contractors Association
- MICA Midwest Insulation Contractors Association
- MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
- NBS National Bureau of Standards
- NEC National Electric Code
- NEMA National Electrical Manufacturers Association
- NFPA National Fire Protection Association
- STI Steel Tank Institute
- UL Underwriters Laboratories Inc.

1.05. QUALITY ASSURANCE

A. Refer to Division 00 and 01, Approved Equals, Substitutions, and Design Clarifications.

B. All products and materials are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.06. PROTECTION OF FINISHED SURFACES

A. Refer to Division 01, General Requirements, Protection of Finished Surfaces.

1.07. SLEEVES AND OPENINGS

A. Refer to Division 01, General Requirements, Cutting and Patching.

1.08. SEALING AND FIRESTOPPING

A. Sealing and fire stopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.09. OFF SITE STORAGE

A. Prior approval by Owner and the A/E will be needed. Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off site storage. No material will be accepted for off site storage unless shop drawings for the material have been approved.

1.10. CODES

A. Comply with requirements of state and local codes, Fire Marshal, and Authority Having Jurisdiction, regarding design, materials and installation.

1.11. DESIGN CRITERIA

A. Design fire protection systems in accordance with codes, standards and regulations noted above.

1. The term “This Contractor” in Division 21 shall mean “Fire Protection Contractor”.

B. This specification for the Fire Protection Work is a "performance" specification. It is intended to establish a general design criteria for the work. The Fire Protection Contractor shall assume full responsibility for design, hydraulic calculations, layout, details, final selection & sizing of all equipment, components, etc. and to incorporate all additional requirements of the Owner, Architect, Insurance Authorities, State, and Local Codes. No adjustment in compensation shall be made for adjustments to minimum equipment capacities and sizes specified.

C. The work of this section includes the furnishing of all labor, tools, fabricated materials, equipment and performing all operations necessary to install the fire protection system, including but not limited to shop drawings, piping, fittings, sprinkler heads, valves, controls, alarms, hangers, and other supplemental items necessary to complete the system in accordance with these specifications.

D. It shall be the responsibility of the Fire Protection Contractor to review the construction documents of all trades involved to determine incidental fire protection required, visit the site and to verify all existing conditions affecting the work and he shall adapt the new work and meet with the approval of all governing bodies. Failure to do so will not result in award of additional payment, for it is to be understood that tender of proposal carries with the agreement a system whole and complete, ready for test and operation and duly approved by agencies as previously noted herein.

E. Prior to installation, complete working drawings must be approved by the Engineer, Owner and Architect. Verify all measurements, distances, levels, etc. before starting work.

F. Include all taxes, plan approval fees, permits and tests required for the Fire Protection Work.

G. Notify all authorities whenever sprinkler system valves are closed.

H. Unless otherwise noted, all materials and equipment used in this installation shall be new and of best quality of their respective kinds, and all work shall be executed in a neat and workmanlike manner. All materials to be UL listed.

I. In the event specifications are not in full accord and changes, alterations, additions or deductions are necessary, or any exceptions in regard to size of equipment, pipe sizes, etc. or layout are taken by this Contractor, notify the Engineer or Owner immediately, in writing and wait his decision. Such exceptions must be submitted ten days prior to date set for receiving of proposal.

J. Whenever the location of piping or equipment is governed by architectural features, this Contractor shall establish their locations by referring to the architectural drawings. Any offsets or relocating of piping shall be done by this Contractor at no additional cost to the Owner. He shall not scale the drawings for exact dimensions.

K. After proposals are accepted by Owner, it shall be understood that this Contractor has studied the drawings, specifications, job site, and no further exceptions will be taken affecting contract amount due to his failure to comply herewith.

L. This Contractor shall inspect all conditions and where possible, field measure for sizing, routing and installation of all equipment and material.

M. Measurements and determination of routing must be complete prior to ordering any equipment or fabricating any materials.

N. Coordinate with all other trades prior to installation to determine locations and methods for installation of equipment and materials.

O. This Contractor shall be responsible for all openings, sleeves, patching, pipe concealment, and finishing required for the installation of the automatic sprinkler systems.

P. Each building shall be provided with hose stream allowances per NFPA 13.

Q. Hydraulically design system for the most remote area based on the requirements of NFPA FM Global Owner's insurance carrier and Authority Having Jurisdiction, (AHJ).

R. The following water supply data for system design will need to be obtained from civil or the local utility:

Test Date:

Performed By:

Hydrant Location	Flow GPM	Static PSI	Residual PSI

S. Water test data is preliminary for bidding purposes. Verify and obtain any additional test data required for design. Tests to be representative of high water use periods.

T. **Prefabrication of piping shall be done at contractor's risk. Extra compensation for modifications to prefabricated piping shall not be permitted. Sprinkler piping installation shall not commence until all ventilation equipment and major runs of ductwork have been installed.**

U. Contractor shall determine the need for fire pump system based on flow and pressure information in Paragraph 1.11.R above.

1.12. CERTIFICATES, INSPECTIONS, AND PERMITS

A. Refer also to Division 00 and 01.

B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer. Deliver originals of these certificates to the Division's Construction Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

1.13. SUBMITTALS

A. Refer also to Division 00 and 01.

B. Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to submit the following fire protection system data sheet. List piping material types, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves, specialties and equipment with manufacturer and model number.

FIRE PROTECTION SYSTEM DATA SHEET

Item	Pipe Service/Sizes	Manufacturer/Model #	Remarks
Pipe			
Fittings			
Hangers & Supports			
Sprinkler Heads			
Valves			
Specialty Valves			
Pipe Specialties			
Fire Protection Specialties			
Fire Protection Equipment			

C. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.

D. Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas and discharge densities.

1. Include allowance in bid for one preliminary submittal to the Architect / Engineer indicating sprinkler head layout and location of mains and branch piping in finished areas with exposed structure. This shall include plans and specifications.

E. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, sprinkler demand and in-rack sprinkler demand. Where a fire pump is used, graph primary rating point, secondary rating point and churn pressure of pump and combined water supply.

F. Submit sufficient quantities of data sheets and shop drawings in accordance with Division 00 and 01.

1.14. OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Division 01.

B. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

- Copies of all approved submittals along with approval letters.
- Manufacturer's wiring diagrams for electrically powered equipment.
- Records of tests performed to certify compliance with system requirements.
- Certificates of inspection.
- Parts lists for equipment and specialties.
- Manufacturers installation, operation and maintenance recommendations for equipment and specialties.
- Valve schedules
- Lubrication instructions, including list/frequency of lubrication
- Warranties
- Additional information as indicated in the technical specification sections

1.15. TRAINING OF OWNER PERSONNEL

A. Instruct Owner's personnel in the proper operation, maintenance and testing of systems and equipment provided as part of this project. Include not less than 2 hour(s) of instruction, using the Operating and Maintenance manuals and record drawings during this instruction. Demonstrate testing, startup and shutdown procedures for all equipment. All training to be during normal working hours. Video record all instructions and provide Owner with copy.

1.16. RECORD DRAWINGS

A. Refer to Division 01, Project Closeout.

B. In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings and calculations with the Operating and Maintenance Manuals.

1.17. ELECTRONIC MEDIA

A. Refer to Division 01.

1.18. WARRANTY

A. Refer to Division 00.

PART 2 - PRODUCTS

2.01. ACCESS PANELS AND DOORS

A. LAY IN CEILINGS: Removable lay in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 09 are sufficient; no additional access provisions are required unless specifically indicated.

B. METAL PAN CEILINGS: Removable sections of ceiling tile held in position by a pressure fit will be provided under Division 09.

C. PLASTER WALLS AND CEILINGS: 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.02. IDENTIFICATION

A. STENCILS: Not less than 1/2" high letters for pipe sizes 1" through 2-1/2" and 1 inch high letters/numbers for pipe sizes 3" and above for marking pipe and equipment. Apply flow arrows to piping.

B. ADHESIVE LABELS: Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4” min. size for lettering and surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton Opti-Code, or equal. Clean piping before application.

C. SNAP-AROUND MARKERS: One-piece, pre-formed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling, 3/4” min. size for lettering. Provide nylon ties on each end of pipe marker.

D. SIGNS: Metal construction, baked porcelain enamel finish signs, sizes conforming to NFPA No. 13 and 7-1.2, with holes and s-hooks/chains for hanging or securing. With applicable labeling. Seton or equal.

E. ENGRAVED NAME PLATES: White letters on a black background, 1/16” thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

F. VALVE TAGS: Round brass tags with 1/2 inch numbers, 1/4" system identification abbreviation, 1-1/4” minimum diameter, with brass jack chains with brass "S" hooks or one piece nylon ties around the valve stem, available from EMED Co., Seton Name Plate Company, or W. H. Brady.

2.03. SEALING AND FIRESTOPPING

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

1. Manufacturers: STI/SpecSeal, Hilti, or approved equal.

2. All fire stopping systems shall be provided by the same manufacturer.

3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the State of Arkansas.

B. Submittals:
Contractor shall submit product data for each fire stop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

1. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.

2. Use fire stop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, fire stop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

C. NON-RATED PENETRATIONS:

1. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the building interior.

2. At pipe penetrations of interior partitions, floors and exterior walls, use urethane caulk in annular space between pipe insulation and sleeve.

PART 3 - EXECUTION

3.01. CONCRETE WORK

A. Cast-in-place concrete within the building will be performed by the Fire Protection contractor in accordance with Division 03.

3.02. CUTTING AND PATCHING

A. Refer to Division 01, General Requirements, Cutting and Patching.

3.03. BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.04. EQUIPMENT ACCESS

A. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in General Construction are to be furnished by the Fire Protection Contractor.

3.05. COORDINATION

A. Coordinate all work with other Contractors prior to installation. Any work that is not coordinated and that interferes with other Contractor's work shall be removed or relocated at the installing Contractor's expense.

B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

3.06. IDENTIFICATION

A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion.

B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

C. Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background or approved pipe marking label systems.

D. Identify valves with signs per NFPA rulings.

E. Provide hydraulic design information sign of permanently marked weatherproof

metal or engraved nameplate material. Secure to alarm valve with brass chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

3.07. LUBRICATION

A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.08. SLEEVES

A. Provide galvanized sheet metal sleeves for fire rated pipe penetrations through interior and exterior walls to provide a backing for sealant or fire stopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In new and or existing poured concrete walls penetrations shall not be core drilled until written approval is obtained by the Contractor from the Structural Engineer. Grout holes directly around steel pipe.

B. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe, cast in place.

C. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 3/4 inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

3.09. SEALING AND FIRESTOPPING

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

1. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.

2. Where fire stop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Fire stop mortar alone is not adequate to support substantial weight.

B. NON-RATED PARTITIONS:

1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.

2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

SECTION 21 05 29 FIRE PROTECTION: HANGERS & SUPPORTS

PART 1 - GENERAL

1.01. SCOPE

A. This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS
- Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Pipe Hanger Rods
- Beam Clamps
- Concrete Inserts
- Continuous Concrete Insert Channels
- Anchors
- Equipment Stands
- Corrosive Atmosphere Coatings

PART 3 - EXECUTION
- Installation
- Hanger and Support Spacing
- Riser Clamps
- Anchors

1.02. RELATED WORK
- Division 03 Concrete
- Section 21 10 00 Water Based Fire Suppression Systems
- Section 21 30 00 Fire Pumps

1.03. REFERENCE

A. Applicable provisions of Division 01 shall govern work under this section.

1.04. REFERENCE STANDARDS

- MSS SP-58
- MSS SP-69
- NFPA 13 Installation of Sprinkler Systems (Latest prevailing edition)
- NFPA 14 Installation of Standpipe and Hose Systems (Latest prevailing edition)
- NFPA 20 Installation of centrifugal fire pumps (Latest prevailing edition)
- UL Underwriter's Laboratories Listed FM Factory Mutual Approved

1.05. QUALITY ASSURANCE Refer to Division 01, General Conditions, Equals and Substitutions.

1.06. DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.

C. Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.

D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

E. For piping hung from open-web steel joists, the following is required:

1. All hung equipment shall be supported within 3" of the structural joist panel points or this contractor shall provide joist stiffeners as indicated on the structural plans.

2. For 6" diameter or larger pipes, or combinations of pipes with a load equal to or greater than a 6" diameter.

a. If the pipe runs parallel to joists, locate the pipe midway between and support equally off of two joists. Locate supports at joist panel points at maximum spacing of 8'-0" on center.

b. If the pipe runs perpendicular to joists, provide supports at 10' to 12' on center maximum spacing.

F. Wood Trusses: Contractor shall coordinate with, and receive written approval from truss supplier for the location, weight and fastening methods to be used to hang or attach mechanical, plumbing, and electrical systems prior to truss fabrication. Manufacturer shall consider loss of section in design. If loads cannot be placed at panel points, or the trusses properly field reinforced, truss supplier shall increase bottom chord size as required. Respective subcontractors shall hire a registered P.E. to design connections and hanger supports.

G. Wood I-Joists: Attach sprinkler systems to wood I-joists following guidelines, recommendations and details provided by the I-joist manufacturer and/or the American Plywood Association (APA, www.apaijoist.org).

1.07. SHOP DRAWINGS

A. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

1.08. DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise. Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM listed and approved.

B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

A. B-Line, Grinnell, Pate, Piping Technology, Roof Products & Systems or approved equal.

2.02. STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.03. PIPE HANGERS AND SUPPORTS

A. HANGERS FOR PIPE SIZES 1/2" THROUGH 4": Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF, Grinnell 69 or 70. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Grinnell 260.

B. HANGERS FOR PIPE SIZES 4" THROUGH 8": Carbon steel adjustable swivel ring with 1/2" min. UL/FM approved hanger rods. B-Line B3170NF, Grinnell 69 or 70. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Grinnell 260.

C. HANGERS FOR PIPE SIZES 10" and UP: Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Grinnell 260.

D. MULTIPLE OR TRAPEZE HANGERS: Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and threaded hanger rods or steel channels with welded spacers and threaded hanger rods.

E. WALL SUPPORT: Carbon steel welded bracket with hanger. B-Line 3060 Series, Grinnell 190 Series. Steel channels with pipe clamps.

F. VERTICAL SUPPORT: Carbon steel riser clamp. B-Line B3373, Grinnell 261 for above floor use. Grinnell 40 with bolts and concrete anchors for attachment to underside of concrete floor deck.

G. FLOOR SUPPORT: Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

H. COPPER PIPE SUPPORTS: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturer's clamp and cushion assemblies, B-Line BVT series, Grinnell PS 1400 series.

I. Victaulic Style 009, 005, and 07 rigid couplings, with angle-pattern bolt pads, may be used on IPS steel piping systems, which meet the support and hanging requirements of NFPA 13. An adequate number of Victaulic Style 75 or 77 flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.

2.04. PIPE HANGER RODS

A. STEEL HANGER RODS: Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

B. Size rods for individual hangers and trapeze support as indicated in the following schedule.

Pipe Size	Diameter of Rod
Up to and including 4"	3/8" or 9.5 mm. min.
5", 6" and 8"	1/2" or 12.7 mm min.
10" and 12"	5/8" or 15.9 mm min.

2.05. BEAM CLAMPS

A. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8”, 1/2", and 5/8” diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Grinnell 86/92.

B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2” diameter. B-Line B3054, Grinnell 228.

2.06. CONCRETE INSERTS

A. POURED IN PLACE:

1. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8” diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Grinnell 281.

2. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8” diameter. B-Line B3014N, Grinnell 282.

B. DRILLED FASTENERS:

1. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.07. CONTINUOUS CONCRETE INSERT CHANNELS

A. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8” by 1-3/8” deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with channel inserts may be used. Select insert length to accommodate all pipe sizes in the area.

2.08. ANCHORS

A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.09. EQUIPMENT STANDS

A. Use structural steel members welded to and supported by pipe supports. Clean,

prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

2.10. CORROSIVE ATMOSPHERE COATINGS

A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

B. Corrosive atmospheres include the following locations:
- Exterior locations
- Parking Ramps
- Chemical storage and hazardous waste storage rooms
- Food service/kitchen areas
- Walk-in coolers/freezers
- Locker rooms
- Greenhouses

PART 3 – EXECUTION

3.01. INSTALLATION

A. Size, apply and install supports and anchors in compliance with manufacturer's recommendations.

B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

E. Perform welding in accordance with standards of the American Welding Society.

3.02. HANGER AND SUPPORT SPACING

A. Use hangers with minimum vertical adjustment.

B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

C. Support riser piping independently of connected horizontal piping.

D. Adjust hangers to obtain the slope specified in the piping section of these specification.

E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Horizontal Spacing	Maximum Vertical Spacing
Copper	3/4" through 1”	8’-0”	10’-0”
Copper	1-1/4" through 1-1/2"	10'-0"	10’-0”
Copper	2" through 3"	12'-0"	10’-0”
Copper	3-1/2" through 8"	15'-0"	10’-0”
Steel	1" through 1-1/4"	12'-0"	15’-0”
Steel	1-1/2" through 8"	15'-0"	15’-0”
Steel	8" through 12"	15'-0"	20’-0”

F. Unsupported length from the last hanger and an end sprinkler shall be as follows:

1" piping	Not greater than 36"
1-1/4" piping	Not greater than 48"
1-1/2" piping or larger	Not greater than 60"

3.03. RISER CLAMPS

A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.

3.04. ANCHORS

A. Install anchors at ends of principal pipe runs and at intermediate points in pipe runs. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

BLANK

SECTION 21 10 00 - WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01. SCOPE

A. This section contains specifications for fire protection pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria
- Welder Qualifications

PART 2 - PRODUCTS
- Fire Protection Piping
- Unions and Flanges
- Mechanical Grooved Pipe Connections
- Sprinkler Heads
- Flow Switches
- Pressure Switches
- Local Alarm Bell
- Pressure Gauges
- Valves
- Specialty Valves
- Hose Outlet Valves
- Fire Department Connection
- Fire Pump Test Connection
- Air Compressor
- Preaction Double Interlock Sprinkler System

PART 3 - EXECUTION
- General
- Preparation
- Erection
- Copper Pipe Joints
- Welded Pipe Joints
- Threaded Pipe Joints
- Mechanical Grooved Pipe Connections

Unions and Flanges
Piping System Leak Tests
Installation

1.02. RELATED WORK

Section 21 05 00 Common Work Results for Fire Suppression
Section 21 05 29 Hangers and Supports for Fire Suppression Piping and Equipment
Section 21 30 00 Fire Pumps

1.03. REFERENCE

A. Applicable provisions of Division 01 govern work under this section.

1.04. REFERENCE STANDARDS

ANSI A21.4	
ANSI A21.11	
ANSI A21.51	
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.3	Malleable Iron Threaded Fittings
ANSI B16.4	Cast Iron Threaded Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory Made Wrought Steel Buttweld Fittings
ANSI B16.11	Forged Steel Fittings, Socket Welded and Threaded
ANSI B16.18	Cast Bronze Solder Joint Pressure Fittings
ANSI B16.22	Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
ANSI B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135	Electric Resistance Welded Steel Pipe
ASTM A181	Forgings, Carbon Steel for General Purpose Piping
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A536	Ductile Iron Castings
ASTM A795	Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B88	Seamless Copper Water Tube
AWWA C606	Grooved and Shouldered Joints
AWS A5.8	Brazing Filler Metal
AWS D10.9	Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3
NFPA 13	Installation of Sprinkler Systems. (Latest prevailing edition)
NFPA 14	Installation of Standpipe and Hose Systems. (Latest prevailing edition)

UL	Underwriters' Laboratories Listing
FM	Factory Mutual Approval

1.05. SHOP DRAWINGS

A. Schedule from the Contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

B. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style or series number.

C. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.06. QUALITY ASSURANCE

A. Order all copper and steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

C. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved product utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.08. DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping systems for the highest pressures and temperatures in the respective system but not less than 175 psig.

C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

D. Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

1.09. WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the Owner's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 – PRODUCTS

2.01. FIRE PROTECTION PIPING

A. STEEL PIPE:

1. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.

2. Black steel pipe, Schedule 5, conforming to ASTM A53, A135, and A795

with Pressfit® pressure sealed joints.

3. Threaded light wall pipe and plastic pipe are not acceptable.

B. Pipe Wall Thickness: Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8" and larger cut groove and 8" and larger threaded piping. Schedule 10 up to and including 6" for rolled groove and welded. 0.188" for 8" and 10" rolled groove and welded. Schedule 5 for Pressfit® pressure-sealed joints.

C. Fittings: 2" and Under - Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM Type A gaskets, ASTM A536 ductile iron. or ASTM A53 fabricated steel. Externally zinc-electroplated carbon steel Pressfit® fittings with EPDM o-rings.

D. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

E. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in dry sprinkler or combined pipe systems, preaction systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread or cut groove hot dipped zinc coated pipe ends for fitting connections. Indoor dry standpipe systems supplied by a Fire Dept. connection only may be black steel piping and fittings.

F. COPPER PIPE: Type L copper water tube, H (drawn) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, ANSI B16.22; copper phosphorous brazing alloy, AWS A5.8 BCuP.

2.02. UNIONS AND FLANGES

A. 2" AND SMALLER STEEL: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.

B. 2" AND SMALLER COPPER: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

C. 2-1/2" AND LARGER: ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

D. 2-1/2" AND LARGER COPPER: ANSI B16.24, Class 150 cast bronze flanges with raised face.

2.03. MECHANICAL GROOVED PIPE CONNECTIONS

A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Anvil, or Taco may be used with steel or copper pipe. Mechanical grooved components and assemblies to be rated for minimum 175 psi working pressure unless noted otherwise.

B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. Steel pipe Fittings to be ductile iron A536, short radius, full flow FireLock® fittings with painted finish; where ductile iron fitting pattern not available, fabricated steel fittings shall be used. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153. Fittings shall be supplied with factory grooved ends designed to accept Victaulic couplings.

D. Steel pipe couplings shall consist of two ductile iron housings conforming to ASTM A536, pressure-responsive, synthetic rubber gasket, and plated steel bolts and nuts.

1. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if a torque wrench is used for installation. Required torque shall be in accordance with manufacturer's recommendations.

a. 1-1/4 inch through 4-inch: "Installation ready" rigid joint designed for direct "stab" installation onto grooved end pipe without disassembling the coupling. Victaulic FireLock® EZ Style 009.

b. 5-inch and Larger: Standard rigid joint. Victaulic FireLock® Style 005 or Style 07 Zero-Flex®.

2. Flexible Type: Use in seismic areas where required by NFPA 13. Victaulic Style 75 or 77.

E. Gaskets to be EPDM, Type A, ASTM D2000. Gaskets for dry systems to be flushseal® or Style 009 EZ design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A-183 or ASTM A-449, with zinc electroplated finish.

F. Flange adapters to be ductile iron, ASTM A536; flat faced with Class 125, 150 or 300 bolt-hole patterns, Victaulic Style 741, 744, or 743; except at lug type butterfly valves where standard threaded flanges shall be used.

G. Copper tube fittings shall be wrought copper conforming to ANSI B16.22 with grooved ends designed to accept Victaulic couplings. Flaring of tube and fitting ends to IPS dimensions is not permitted.

H. Copper tube couplings shall consist of two ASTM A-536 ductile iron housings cast with offsetting, angle-pattern bolt pads coated with copper-colored enamel, a pressure-responsive synthetic rubber gasket of a FlushSeal® design, and plated steel bolts and nuts conforming to ASTM A-183 or A-449. Victaulic Style 606.

I. Copper tube flange adapters shall be ASTM A-536 ductile iron casting coated with copper-colored enamel, flat faced for direct connection to flanges with ANSI Class 125 and 150 bolt-hole patterns. Victaulic Style 641.

J. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

K. Seismic movement in mechanical grooved pipe connections shall be accommodated with swing joints, loops, offsets, or Style 155 expansion joints to provide flexibility to the system and help reduce pipe stress and potential system damage as per NFPA 13 Section 6-4.3. Refer to Victaulic submittal #26.12.

2.04. SPRINKLER HEADS

A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco, Reliable, Star Sprinkler, Victaulic and Viking.

B. Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" discharge orifice except where greater than normal density requires large orifice.

C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (155 degree) fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.

D. Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000. Provide steel cabinet for storage of heads and wrenches.

E. **Sprinkler head and escutcheon finish and color shall be selected by Architect. All sprinkler heads shall be located in center of ceiling tile.**

F. Upright: Star Model SG (QR) or Victaulic Model V27 (QR), brass finish.

G. Horizontal Sidewall: Star Model SG (QR) or Victaulic Model V27 (QR), with escutcheon.

H. Vertical Sidewall: Star Model E.

I. Quick Response Pendant: Semi-Recessed.

J. Quick Response Sidewall: Viking Microfast M or Victaulic Model V27, with escutcheon.

K. Dry Pendant (Self-contained type): Viking Model C or Victaulic Model V36, brass finish with brass escutcheon.

L. Dry Pendant (Self-contained type): Viking Model M (Quick Response) or Victaulic Model V36 (Quick Response), adjustable, recessed, with escutcheon.

M. Dry Horizontal Sidewall (Self-contained type): Viking Model M (Quick response) or Victaulic Model V36 (Quick Response), adjustable, recessed, with escutcheon.

N. Flexible Sprinkler Hose Fittings for Fire Protection Service

1. Manufacturer: FlexHead Industries, Inc.

2. Description: Flexible Sprinkler Hose Fittings for use in commercial suspended ceilings and sheetrock ceilings.

a. Regulatory Requirements: In accordance with NFPA 13.

3. Product Performance Criteria:

a. FM Approved for its intended use pursuant to FM 1637 Approval Standard for Flexible Sprinkler Hose with Threaded End Fittings.

b. UL Listed for its intended use pursuant to UL 2443 Standard for Flexible Sprinkler Hose with Fittings for Fire Protection Service.

c. Seismically qualified for use pursuant to ICC_ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

4. Materials: FlexHead Commercial Sprinkler Connections.

a. FlexHead Flexible Hose Assemblies and End Fittings:

1) Composition: 100% Type 304 Stainless Steel.

b. FlexHead Ceiling Bracket:

1) Composition: Type G90 Galvanized Steel.

2) Type: Direct attachment type, having integrated snap-on clip ends positively attached to the ceiling using tamper resistant screws.

3) Flexible Hose Attachment: Removable hub type with set screw.

2.05. FLOW SWITCHES

A. Vane type water flow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system. System Sensor WFD Series.

2.06. PRESSURE SWITCHES

A. Pressure actuated switch with field adjustable settings, metal enclosure and electrical characteristics compatible with alarm system. System Sensor EPS Series.

2.07. LOCAL ALARM BELL

A. Weatherproof electric alarm bell with red painted metal housing, mounting base and gong; solenoid operator; weatherproofing o-ring seal and electrical characteristics compatible with alarm system.

2.08. PRESSURE GAUGES

A. Manufacturer: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.

B. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

2.09. VALVES

A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic (all grooved end valves), Viking, and Watts.

B. BALL VALVES:
1. 2" and smaller: Bronze, 2-piece, threaded, grooved, or sweat ends, standard port, blowout proof stem, chrome plated brass ball, glass reinforced or TFE seats, UL approved @ 250 psi or UL and FM approved @ 350 psi. Watts No. B-6000 UL or Victaulic FireLock® Series 728.

C. GATE VALVES:

1. 2" and smaller: Outside screw and yoke gate valves, 175 psig, bronze body, bronze mounted, screwed bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.

2. 2-1/2" and larger:

   a. Outside screw and yoke gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.

   b. Outside screw and yoke gate valves with grooved ends, 250 psig, ductile iron body, bronze mounted, cast iron flanged bonnet, brass rising stem, resilient wedge, EPDM o-ring stem seals and body gasket. Victaulic FireLock® Series 771.

D. BUTTERFLY VALVES:

1. 2" and smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.

2. 2" and larger: Cast or ductile iron body butterfly valve, lug style or grooved, 300 psig, geared operator with weatherproof actuator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel plated or elastomer coated ductile iron disc. Valve assembly to be bubble tight to 300 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff. Victaulic FireLock® Series 705W.

3. SUPERVISORY/TAMPER SWITCHES: For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.

E. CHECK VALVES:

1. 3" and smaller: Bronze body, threaded end, Y-pattern, re-grindable bronze seat, renewable bronze disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.

2. 2-1/2" and larger: Cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.

3. Provide 1/2" automatic drip drain on inlet of fire dept. connection check valve.

F. SPRING LOADED CHECK VALVES:

1. 2" and smaller: Bronze body, threaded ends, bronze trim, stainless steel

spring, stainless steel center guide pin, 175 psig, Teflon seat unless only bronze available.

2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, 175 psig.

3. 2-1/2” and larger: Ductile iron body, non-slam, silent type check valve with aluminum bronze or elastomer coated ductile iron disc, stainless steel spring and stem, PPS coated or welded-in nickel seat, grooved ends, 250 psig. Victaulic FireLock® Series 717 or 717R with riser check kit.

G. DRAIN VALVES: 3/4" min. two- or three-piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG, with hose thread outlet and cap.

H. DOUBLE CHECK VALVES:

1. Manufacturers: Beeco, Cla-Val, Conbraco, Febco, Watts, and Wilkinson.

2. ASSE 1015 double check backflow preventer with 2 independent spring-loaded check valves, 2 isolation ball or gate valves with normally open tamper switch with double wire leads, 4 valved test ports. Constructed of bronze or epoxy coated cast iron or stainless-steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig.

2.10. SPECIALTY VALVES

A. Manufacturer: Tyco, Reliable, Star Sprinkler, Victaulic and Viking.

B. ALARM CHECK VALVES: Cast or ductile iron body, flanged or grooved ends, 175 psig, brass or bronze grooved seat with o-ring seal, single hitch pin and latch design. Provide trim for bypass, drain, electric sprinkler alarm switch, pressure gages, precision retarding chamber, drip cup assembly piped to floor or hub drain, fill line attachment with strainer. Valve internal parts shall be replaceable without removing the valve from the installed position. Victaulic FireLock® Series 751.

C. DRY PIPE VALVES: Cast or ductile iron body, flanged or grooved ends, 300 psig, brass or bronze grooved seat with o-ring seal, single hitch pin and latch design. Provide trim for air supply, drain, priming level, alarm connections, pressure gages, priming chamber attachment, ball drip valves, drip cup assembly piped to floor or hub drain, fill line attachment with strainer. 13 psig minimum required air pressure. Valve internal parts shall be replaceable without removing the valve from the installed position and be externally resettable. Valve shall be supplied pre-trimmed with a Series 776 low pressure actuator and Series 728 or 705W shutoff valve. Victaulic FireLock® NXT Series 768.

D. AIR PRESSURE MAINTENANCE DEVICE: Automatic control capable of maintaining system air pressure, rated for 175 psig, adjustable air pressure range of 15 to 60 psig, complete with isolation valves, bypass fill valve, pressure regulator or pressure switch and strainer. Victaulic Series 757P.

E. DELUGE VALVES: Cast or ductile iron body, flanged or grooved ends, 300 psig, brass or bronze grooved seat with o-ring seal. Provide trim for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped to floor or hub drain, fill line attachment with strainer and push rod chamber assembly. Include dry pilot trim consisting of pneumatic actuator, air and water pressure gages, low air warning switch, air relief valve and diaphragm actuation device with replaceable brass or bronze seat and resilient diaphragm. 13 psig minimum required air pressure. Valve internal parts shall be replaceable without removing the valve from the installed position and be externally resettable. Valve shall be supplied pre-trimmed with a Series 776 low pressure actuator and Series 728 or 705W shutoff valve. Victaulic FireLock® NXT Series 769.

F. EMERGENCY PULL BOX: 1/2" ball valve in metal enclosure with 1/2" pipe nipple, "Manual Emergency Station" label and breakaway door.

2.11. HOSE OUTLET VALVES

A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. ALLEN

B. CLASS I AND CLASS III SYSTEMS: 2-1/2" (chrome plated) brass angle valve, 300 psig, with removable red handwheel, 2-1/2"x1-1/2" reducing lug pin connector coupling and National Standard male hose thread outlet, cap and chain. Provide N.P.T. female outlet where hose is required.

C. CLASS II SYSTEMS: 1-1/2" (chrome plated) brass angle valve, 300 psig, with red handwheel and National Standard male hose thread outlet, cap and chain. Provide N.P.T. female outlet where hose is required.

D. CLASS III SYSTEMS: 2-1/2" (chrome plated) brass angle valve, 300 psig, with red handwheel and National Standard male hose thread outlet, cap and chain.

2.12. FIRE DEPARTMENT CONNECTION

A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. ALLEN

B. FLUSH: Polished cast brass(chrome plated) or ductile iron flush fire department inlet, two-way (three-way, four-way, six-way) inlet body, swing clappers, pin-lug swivels and caps with chains, 2-1/2" National Standard female hose thread inlets, 6"(4") outlet, cast brass (chrome plated)lettered identification backplate.

C. Where applicable, install a 90-degree elbow with drain connection at each Fire

Department connection for complete system drainage. Elbow shall be Victaulic #10-DR.

2.13. AIR COMPRESSOR

A. Manufacturer: Quincy, Ingersoll Rand, Nash, and Viking.

B. Multi-Zone and large systems: Simplex electric motor belt driven oil lubricated compressor mounted on ASME rated galvanized receiver tank, pressure operated electric switch, motor, magnetic motor starter with three phase overload protection, fused disconnect switch, safety relief valve, check valve, shutoff valve, pressure gauge, automatic tank drain, intake muffler-filter, belt guard and adjustable operating pressure control.

C. Single zone and small systems: Riser pipe mounted air compressor installation. Electric motor driven, air cooled, oil-less, adjustable, single stage compressor. With check valve, pressure switch, pressure relief valve, mounting bracket kit and air filter assembly. Equal to General OL Plus Series (or Q series, 55-60 dBA, for applications near offices or sleeping rooms) or Victaulic Series 7C7 with air maintenance device and flexible hoses for installation.

D. Refer to Electrical drawings for required voltage and phase.

2.14. PREACTION DOUBLE INTERLOCK SPRINKLER SYSTEM

A. The Contractor shall furnish and install a double interlocked automatic sprinkler system including, but not limited to: valves, trim, piping, sprinkler heads, Cheetah Xi control panel, detectors, wiring, pressure switches, alarm devices, and all incidental devices required for a complete and operational system.

1. Air Sampling Fire Detection System:

a. The contractor shall provide and install a complete VESDA air sampling laser plus fire detection system.

b. The system shall be installed in strict compliance with the manufacturer’s recommendations.

c. The VESDA system shall be integrated with the Fike Cheetah control panel through a HLI (high level interface) module, and have the ability to be isolated during routine building maintenance procedures.

B. The work described in this specification consists of all labor, materials, equipment and services required to complete and test the double interlocked sprinkler and fire detection systems.

C. Horns and strobes shall have the ability to be isolated for alarm testing.

D. Drawings: The Contractor shall provide shop drawings for this system. The drawings shall clearly illustrate the complete system including, but not limited to the following:
   - Riser diagram
   - Piping and sprinkler head layout
   - Detection system
   - All details necessary for installation

E. The system shall be designed to require both a sprinkler head and a detector to operate before the main valve is opened.

F. Materials and equipment shall be standard products of the manufacturer's latest design, and suitable to perform the functions intended. The name of the manufacturer and the serial number shall appear on all major components. All devices and equipment shall be UL listed and FM approved.

PART 3 – EXECUTION

3.01. GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

B. All piping in areas with ceilings shall be concealed unless indicated otherwise.

3.02. PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03. ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.

B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

C. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and pre-action systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade. Install auxiliary drains as required.

H. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

I. Do not route piping within exterior walls.

J. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

K. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04. COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation and assemble joint to socket stop. Apply flame to fitting until brazing alloy melts when placed at joint. Wipe excess alloy from joint.

3.05. WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

3.06. THREADED PIPE JOINTS

A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.07. MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's

(Victaulic) specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's (Victaulic) specifications.

B. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory trained field representative (direct employee) shall provide on-site training to contactor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.08. UNIONS AND FLANGES

A. Install a union, flange or grooved coupling combination at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the valve. Concealed unions, flanges or couplings are not acceptable.

3.09. PIPING SYSTEM LEAK TESTS

A. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

B. Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Entire test must be witnessed by the Division's representative.

C. Use clean water and remove air from the piping being tested where possible. Measure and record test pressure at the high point in the system.

D. Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig, test at a pressure 50 psig above system design pressure.

E. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

3.10. INSTALLATION

A. Install fire protection system components in accordance with NFPA rulings, listings and manufacturers recommendations. Locate where accessible for servicing and replacement.

B. Sprinkler Heads: Locate sprinkler heads maintaining minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to spray pattern interference. Provide fire sprinkler head installations below ductwork, soffits, etc. Install guards on sprinkler heads within mechanical rooms, boiler rooms, and gymnasiums.

C. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors/ Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

D. Switches: Locate flow and pressure switches where indicated and where required to obtain specified zoning to isolate floors and major areas of floors. Provide valved test connection for flow switch adjacent to flow switch. Pipe to floor drain. Test flow switch to verify proper operation.

E. Gauges: Provide a valved pressure gauge in main fire protection riser, at the top of each piping riser, at inlet and outlet of pump and elsewhere as indicated.

F. Valves: Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

G. Specialty Valves: Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to grade drains. Test and adjust operation of valves, alarms, pressure maintenance devices, emergency pull boxes and deluge/pre-action controls.

H. Hose Outlet Valves: Install at each standpipe outlet and elsewhere where indicated approximately 4' above floor.

I. Fire Department and Fire Pump Test Connections: Mount on wall where indicated. Support from structure independent of piping. Locate between 2' to 3' above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weather tight.

J. Air Compressor: Install on concrete housekeeping pad, leveled and bolted in place. Pipe automatic drain to floor drain. Install line size ball valve and check valve in discharge line. Install pressure gauge upstream of ball valve.

END OF SECTION

SECTION 22 0000 - PLUMBING BASICS

PART 1 GENERAL

1.01. SCOPE:

A. Install all fixtures as shown on the plans. Field verify exact locations.

B. Provide all equipment and specialties shown on the plans or specified herein.

C. Provide all necessary support, trim and accessories required.

D. All fixtures indicated to be ADA compliant shall be installed in full compliance with ADA guidelines.

1.02. Fixtures shall be equal to those scheduled on the Drawings.

1.03. All items furnished under this section shall be submitted for approval prior to ordering.

1.04. Fixtures shall meet all applicable code requirements and all authorities having jurisdiction.

PART 2 PRODUCTS

2.01. GENERAL:

A. Fixtures shall be non-absorbent throughout and free from waves, kiln marks or discoloration.

B. All surfaces coming in contact with walls, floors or other flat surfaces shall be flat.

C. All enameled iron ware shall be acid-resisting.

2.02. TRIM:

A. All exposed finished metal parts shall be chromium-plated; except, rough-bodied parts shall be nickel-plated.

B. All supplies shall be IPS brass; except, where otherwise specified.

C. All fixtures will be provided with supply stop.

D. Traps for lavatories and sinks shall be chrome-plated cast brass P-traps with clean-out.

E. Provide cast brass, chrome-plated, set screw type, escutcheons on supply and waste piping.

F. All trim for ADA fixtures shall be ADA-compliant.

2.03. CLEAN OUTS:

A. Caulking plugs: Cast iron cleanouts for caulking into soil pipe hub with straight threaded, plated raised hex head plug having tapered shoulder that seats against seal.

B. Wall cleanouts for dry wall or block construction shall be cast iron caulking ferrule for soil pipe hub, plated cast iron raised head plug with seal, tapped for machine screw, and stainless-steel round access cover plate secured to plug by counter-sunk brass screw.

C. Wall cleanouts for plaster for tile wall construction shall be cast iron caulking ferrule for soil pipe hub, plated cast iron raised head plug with seal, tapped for machine screw, and cast Nickel alloy round flush access cover with polished top, anchor lugs, and cover plate secured to plug by counter-sunk brass screw.

D. Floor cleanouts shall be adjustable cast iron floor cleanout, coated cast iron internal cleanout plug with seal, polished nickel alloy rim and round scoriated cover plate, secured to plug by counter-sunk screw. Provide recessed top where cleanout occurs in tile floor. Provide cleanout marker when cleanout occurs in carpet.

E. Cleanouts to grade shall be cast iron cleanout, plated cast iron counter-sunk plug with seal, adjustable head and heavy-duty loose set round scoriated tractor cover.

2.04. WATER HEATERS:

A. Provide tank water heaters with ASTM rated T&P valve. T&P valve shall discharge per authority having jurisdiction, full size to outside the building or to an indirect waste receptor by means of an air gap.

B. Provide tank water heater with drain pan per authority having jurisdiction.

C. Provide tank water heater with Thermal Expansion tank per authority having jurisdiction.

PART 3 EXECUTION

3.01. All fixtures subject to damage prior to completion of building shall be protected in an approved manner. Job must be turned over to Owner with all fixtures clean and free from damage.

3.02. All wall-hung water closets and urinals shall be supported on chair carriers.

3.03. Unless specified to be furnished with chair carrier, wall-hung lavatories, sinks, and other fixtures. shall be secured to wall with back-up plate and threaded rods. Contractor shall provide all backing, reinforcing, hangers, bolts, anchors and brackets required.

3.04. Fixtures mounted and on uneven surfaces shall be bedded in an approved manner as per fixture manufacturer, owner, and engineer.

3.05. All hot and cold water supplies to plumbing fixtures or to shower heads shall have a drop-ear fitting secured to prevent movement.

3.06. AMERICANS WITH DISABILITIES ACT

A. All plumbing facilities shall be installed in compliance with the requirements of the Americans with Disabilities Act. Requirements include the following:

1. Water closet flush controls shall be mounted on the wide side of the toilet area.

2. Tub controls shall be mounted on the end wall on the entry side of the tub centerline.

3. Shower controls on stalls up to 36” wide shall be mounted on the side wall opposite the seat on the entry side of the shower centerline, and on stalls up to 60” wide shall be mounted on the back wall on the right side of the centerline.

4. Hot water piping and traps on fixtures supplied with hot water shall be insulated.

5. All controls and operating mechanisms shall be operable with one hand and without tight grasping, pinching, or twisting of the wrist.

B. Fixture and controls mounting heights, clear knee space, access clearances, etc. shall comply with ADA required dimensions, and as on details or schedules when shown.

3.07. Do not route piping through electrical or electronic enclosures, or above electrical gear located in other areas unless unavoidable. Install drip pan under piping which must be run through electrical spaces. Installation to be per National Electrical Code and as approved by local authority.

END OF SECTION

SECTION 22 0015 - FIRESTOPPING AND SMOKE STOPPING

PART 1 - GENERAL

1.01. SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.

B. Scope:

1. The scope of the work shall include the mechanical systems, HVAC piping and ductwork, plumbing piping, fire protection piping, and other systems installed by the contractor.

1.02. 1.02 REFERENCES

A. Underwriters Laboratories

1. U.L. Fire Resistant Directory

a. Through-penetration firestop devices (XHCR)

b. Fire resistance ratings (BXUV)

c. Through-penetration firestop systems (XHEZ)

d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards:

1. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.03. 1.03 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time rated fire walls, time rated ceiling/floor assemblies, and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

F. Sleeve: Metal fabrication or pipe section extending through thickness off barrier and used

to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

1.04. SYSTEM DESCRIPTION

A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

1.05. SUBMITTALS

A. Submit in accordance with general conditions unless otherwise indicated.

B. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication

2. Manufacturer's installation instructions.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL System number, or UL classified devices.

2. Manufacturer or manufacturers’ representative shall provide qualified engineering judgements and drawings relating to non-standard applications as needed.

D. Quality control submittals:

1. Statement of qualifications.

E. Applicators' qualifications statement:

1. List past projects indicating required experience.

1.06. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum

three years documented experience and approved by manufacturer.

1.07. REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

1.08. ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

D. Furnish forced air ventilation during installation if required by manufacturer.

E. Keep flammable materials away from sparks or flame.

F. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

G. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.09. SEQUENCING

A. Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

1.10. QUALITY ASSURANCE

A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.

2. At least 2 years' experience with systems.

3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

1.11. DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instruction.

1.12. PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

1.13. GUARANTEE

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

PART 2 PRODUCTS

2.01. THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems or devices listed in the U.L. Fire Resistance Director under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.

1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.

2. Acceptable manufacturers and products: Those listed in the U.L. Fire Resistance directory for the U.L. System involved and as further defined in Part 3.06 of this section.

3. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer.

4. Products shall be 3M firestopping products and systems or equal.

2.02. SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-Penetration Smoke-Stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

B. Construction-Gap Smoke-Stopping: Any system complying with the requirements for construction-gap firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.03. MATERIALS

A. Firestopping Material: Single or multiple component silicone elastomeric rubber type foam compound mixed with incombustible non-asbestos ceramic fibers.

B. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

2.04. 2.04 ACCESSORIES

A. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.

B. Forming materials: As classified under Category XHKU in the U.L. Fire Resistance Directory.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.02. SURFACE PREPARATION

A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.03. INSTALLATION

A. Apply primer and materials in accordance with manufacturer’s instructions.

B. Install penetration seal materials in accordance with printed instruction of the U.L. Fire

Resistance Directory and in accordance with manufacturer's instruction.

C. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

D. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.

E. Apply firestopping material in sufficient thickness to achieve rating and to a uniform density and texture.

F. Protect materials from damage on surfaces subject to traffic.

G. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

H. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges - installed in accordance with fire damper manufacturer's recommendations.

I. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application. See U.L. Fire Resistance Directory.

J. Install smoke stopping as specified for firestopping.

K. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical 12-inch-wide fiber dams for full thickness and height of air cavity at maximum 15-foot intervals.

L. Dam material to remain.

3.04. FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.05. ADJUSTING AND CLEANING

A. Clean adjacent surfaces of firestopping materials.

B. Clean up spills of liquid components.

C. Neatly cut and trim materials as required.

D. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.06. PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.07. SYSTEMS AND APPLICATION

A. The installation shall be as required by manufacturer for type of construction, Type of U.L. systems, type of penetration, and type of fire stopping system.

END OF SECTION

SECTION 220030 - ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:

A. This section specifies the basic requirements for electrical components which are to be provided for operation of mechanical equipment. These components include, but are not limited to, motors, starters, and disconnect switches when indicated, furnished as an integral part of packaged mechanical equipment, or furnished separately for mechanical equipment.

B. Furnish all motor controllers and contactors, not furnished as part of a motor control center, for proper operation of all motors.

C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections and scheduled on the drawings.

1.02 REFERENCES:

A. NEMA Standards MG 1: Motors and Generators.

B. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment.

D. NEMA Standard KS 1: Enclosed Switches.

E. National Electric Code (NFPA 70).

1.03 SUBMITTALS:

A. Separate submittal is not required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.04 QUALITY ASSURANCE:

A. Electrical components and materials shall be UL labeled.

B. The electrical work shall comply with the National Electric Code.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Equipment shall be by same manufacturer, except those items furnished by an equipment manufacturer as an integral part of his equipment. Where possible the equipment shall be by the same manufacturer specified by electrical.

2.02 MOTORS: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are included in the individual equipment

specifications.

A. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

B. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

C. 2-speed motors shall have 2 separate windings on poly-phase motors.

D. Temperature Rating: Rated for 40 degree C (104-degree F). environment with maximum 90 degree C (194-degree F) rise for continuous duty at full load (Class B insulation).

E. Starting Capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly spaced starts per hour for manually controlled motors.

F. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

G. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

1. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.

2. Bearings:

a. Ball or roller bearings with inner and outer shaft seals.

b. Re-greaseable, except permanently sealed where motor is normally inaccessible for regular maintenance.

c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.

3. Enclosure Type:

a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.

b. Guarded drip-proof motors where exposed to contact by employees or building occupants.

c. Weather protected Type I for outdoor use, Type II where not housed.

4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

5. Noise Rating: "Quiet".

6. Efficiency:

a. Motor shall comply with the efficiency requirements of the Energy Independence and Security Act of 2007.

b. Motors smaller than 1 HP shall have minimum full load efficiencies levels per NEMA Standards.

c. Motors 1 HP and larger shall be premium efficiency.

7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

2.03 STARTERS, ELECTRICAL DEVICES, AND WIRING:

A. Motor Starter Characteristics:

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R or NEMA 12 with conduit hubs installed by contractor, or units in hazardous locations which shall have NEC proper class and division.

2. Type and size of starter shall conform to adopted standards and recommended practices of the National Electric Code and Underwriters' Laboratories.

B. Manual Switches: Manual switches shall have:

1. Pilot lights and extra positions for multi-speed motors.

2. Overload protection: Melting alloy type thermal overload relays.

3. Manual starters / switches are to be used on fractional horsepower motors only.

C. Magnetic Starters:

1. Momentary contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

2. Trip-free thermal overload relays, each phase.

3. Interlocks, witches and similar devices as required for coordination with control requirements of controls sections.

4. Built-in 120 volt control circuit transformer, with 2 primary and one secondary fuse, where service exceeds 240 volts. Fuses sized to carry holding coil circuit and other connected devices.

5. Externally operated manual reset.

6. Under-voltage release or protection (3-wire control).

7. Branch circuit protection shall meet type 2 coordination protection.

8. A hand-off-auto selector switch shall be provided in addition to start-stop buttons for all devices being controlled automatically.

9. Phase loss relay.

a. Provide protective relays with DPDT 600V rated contacts, locking potentiometer undervoltage adjustment, and LED indicating light at each

starter for motors greater than 5 HP. Equal to Square D Class 8430, Type MPD, mounted in suitable enclosure.

D. Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Heater Contactors:

1. Contactors for resistance heat shall be by same manufacturer as starters unless furnished with heaters. Contactors shall be of the magnetic type and mounted in NEMA Type 1 general purpose enclosure. Contactors shall carry a UL listing and shall be rated for 100,000 cycles.

F. Disconnect Switches:

1. Fusible Switches: Fused, each phase; heavy duty; horsepower rated; non-teasible, quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "open" position; arc quenchers; capacity and characteristics as indicated.

2. Non-fusible Switches: For equipment less than 1 horsepower, switches shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment 1 horsepower and larger, switches shall be the same as fusible type.

2.04 CAPACITORS:

A. Features:

1. Individual unit cells, all welded steel housing, each capacitor internally fused, non-flammable synthetic liquid impregnant, craft tissue insulation, and aluminum foil electrodes.

2. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger that have an uncorrected power factor of less than 85 percent at rated load.

PART 3 - EXECUTION

3.01 GENERAL

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters and wiring devices which have not been factory-installed on equipment

unit to electrical installer for installation.

C. Install starters and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate for proper operation access, including visibility, and for safety. Do not cover equipment data or informational tags when device is to be mounted on equipment.

D. Install control connections for motors to comply with NEC and applicable provisions of Electrical. Install equipment grounding except where non-grounded isolation of motor is indicated.

E. Connect protective relays to line side lugs of the motor starter and wire control contacts into motor starter circuit.

F. Label starters with engraved plastic nameplate describing the equipment served, e.g., "A.C. Unit No. 1". Nameplates shall be U.V. stabilized for use indoor / outdoor. Attach nameplates with clear silicone sealant.

END OF SECTION

SECTION 22 00 75 - PLUMBING IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following mechanical identification applications:

1. Equipment identification.
2. Pipe identification.
3. Valve tags.
4. Valve schedule.

1.2 SUBMITTALS

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

B. Product Schedule: Provide schedule indicating each type of identification material to be used for equipment, piping, and ductwork. Indicate colors to be used.

C. Valve Schedule: Submit a valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Provide three (3) copies. Mark valves which are intended for emergency shut-off, normally open, normally closed, and similar special uses by special flag in the margin of the schedule. Include the following for each valve:

1. Valve identification number
2. System
3. Purpose
4. Location
5. Type
6. Size
7. Manufacturer

1.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems", for letter size, length of color field, for colors not included in the schedule herein, and for viewing angles of identification devices for piping.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 EQUIPMENT IDENTIFICATION

A. Engraved Plastic Laminate Identification Signs

1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where using adhesive mounting.

2. Thickness: 1/16 inch for units up to 20 inches square or 8 inch length; 1/8 inch for larger units.

3. Fasteners: Self tapping stainless steel screws except use contact-type, permanent adhesive where screws cannot or should not penetrate the substrate. Where sign cannot be attached directly to device or equipment, attach with brass chain.

4. Letter sizes: Minimum ¼ inch for names of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

2.2 PIPE IDENTIFICATION

A. Subject to compliance with requirements, provide pipe markers by one of the following:

1. Seton
2. Brady
3. Brimar
4. EMED

B. All above grade piping shall be identified with pipe markers with colors as indicated. Identification shall have proper legend and meet OSHA specifications. Comply with ASME A13.1, unless otherwise noted.

C. For piping where diameter including insulation is less than 8 inch, pipe markers shall be plastic, pre-tensioned, semi-rigid type that encircles entire pipe without the use of adhesives. Tape and sticker types are unacceptable.

D. For piping where diameter including insulation is 8 inch or greater, pipe markers shall be plastic, full-band, semi-rigid type strapped to pipe using manufacturer's standard stainless steel bands.

E. Underground line markers: Manufacturer's standard permanent, bright colored, continuous printed, plastic tape intended for direct burial service, not less than 6" wide and 4 mils thick. Provide tape with printing which most accurately indicates the type of buried pipe.

F. Identification Schedule:

Piping System	Legend	Band/Text Color
1. Plumbing Piping System		
Cold Water	Cold Water	Green/White
Hot Water	Hot Water	Green/White
2. Gas Piping System		
Low Pressure Natural Gas	Low Pressure Gas	Yellow/Black
High Pressure Natural Gas	High Pressure Gas	Yellow/Black
Gas Vent	Gas Vent	Yellow/Black
3. Sanitary Sewer System		
Sanitary Waste	Sanitary Sewer	Green/White
Sanitary Vent	Sanitary Vent	Green/White
4. Storm Drain System		
Storm Drain	Storm Drain	Green/White
5. Miscellaneous Piping Systems		
Compressed Air	Air (PSI)	Blue/White
Welding	Weld	White/Black
Lawn Sprinkler	Non-Potable Water	Green/White

G. Arrows and lettering shall be black. Arrows shall point in the direction of flow. Locate downstream of pipe legend.

H. Arrows shall be of same color as bands and shall point in direction of flow. Locate downstream of pipe legend.

I. Valve Identification: Provide brass tags for all valves and steam traps with legend describing function of each valve and trap. Tag shall also indicate normally open or normally closed, where position is noted on the drawings.

J. Valve Tags: Brass tags shall be a minimum of 2" diameter or 3-1/2" oval, to accommodate 1" high numbers. Tag shall be equipped with a 3/16" X 6" long brass chain.

2.3 STENCILS

A. Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4" for ducts; and minimum letter height of ¾" for equipment and access door signs. Use alkyd paint. Use stencils only as directed herein.

PART 3 EXECUTION

3.1 EQUIPMENT IDENTIFICATION

A. Provide permanent, factory, operational data, nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Where manufacturer's nameplate is not stamped or engraved, provide additional heavy gauge, aluminum or brass, stamped or engraved nameplate. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.

B. In addition to factory nameplate, provide an engraved plastic laminate (stenciled) identification sign for each major item of mechanical equipment and each operational device. Provide identification signs for the following general categories of equipment.

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Compressors, pumps, and similar motor-driven units.

3. Tanks and pressure vessels.

4. Strainers, filters, humidifiers, water treatment systems, and similar equipment.

5. Control panels.

6. Fuel burning units, such as boilers, furnaces, and heaters.

C. Provide engraved sign at each access door, indicating equipment or device to be accessed.

D. Coordinate names, abbreviations, and other designations used in equipment identification with corresponding designations shown, specified, scheduled, or as designated by the Owner's representative. Provide numbers, lettering, and wording as indicated or as directed by the Owner's representative. Owner shall set priority for lettering and graphics. Where multiple systems of the same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, AHU-1H, Standpipe G14).

E. Provide Ceiling Grid Labels for Equipment:

1. Letter Color: Black

2. Background Color: White

3. Minimum Label Size: Length may vary for required label content, but dimensions shall not be less than 2-1/2 by 3/4 inch.

4. Minimum Letter Size: 1/2 inch.

5. Self adhesive, compatible with label and with substrate.

6. Locate on ceiling grid or access door nearest access side of equipment.

3.2 PIPE IDENTIFICATION

A. Provide 1" thick molded fiberglass insulation with jacket under each plastic pipe marker to be installed on uninsulated pipes where fluid temperatures will be 125°F or greater. Insulation shall extend 4" beyond edges of marker.

B. Valve tags and steam traps shall be numbered as indicated on the valve listing provided to the Owner.

C. As a minimum, identification shall be applied to piping at the following locations:

1. Adjacent to each valve.

2. At each branch and riser take-off.

3. At each pipe passage through wall, floor, and ceiling construction.

4. At each pipe passage to underground.

5. At not more than forty feet spacing on straight pipe runs.

D. Place identification so it can be easily read. Arrows shall be applied to indicate direction of flow.

E. Underground Piping: During back-filling of each exterior underground piping system, install plastic line marker, located directly over buried line no deeper than 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install a single line marker.

END OF SECTION

SECTION 22 0086 - PIPING INSULATION

PART 1 - GENERAL

1.01. SUMMARY

A. Perform all Work required to provide and install piping insulation, jackets, and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.

B. Insulation of Underground Piping is specified elsewhere and not work of this Section.

1.02. REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.

3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.

4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.

5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

9. ASTM C547 - Mineral Fiber Pipe Insulation.

10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

14. ASTM C450 - Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.

15. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.

16. ASTM C921 - Jackets for Thermal Insulation.

17. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

19. ASTM D1667 - Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell).

20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

21. ASTM C795 - Insulation for Use Over Austenitic Steel.

22. ASTM E84 - Surface Burning Characteristics of Building Materials.

23. ASTM E96 - Water Vapor Transmission of Materials.

24. NFPA 255 - Surface Burning Characteristics of Building Materials.

25. UL 723 - Surface Burning Characteristics of Building Materials.

26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.03. DEFINITIONS

A. Concealed: Areas that cannot be seen by the building occupants.

B. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.

C. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.

D. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

E. Unconditioned Space: Interior space that is not temperature-controlled by cooling and/or heating system. Includes attics, chases, unconditioned living spaces and non-conditioned equipment rooms.

1.04. QUALITY ASSURANCE

A. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, and accessories utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50

smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.

1. Certificates to this effect shall be submitted along with submittal data.

2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

C. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years' experience specializing in the trade.

D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.

F. Stainless Steel: Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36. These requirements are for prevention of external stress Corrosion Cracking (ESCC) for austenitic stainless steel.

1.05. SUBMITTALS

A. Prepare a schedule of piping insulation showing systems insulated. For each system, show insulation type, thickness, temperature rating, and special conditions where applicable.

B. Submit product data for each piping system. Product data shall include but not be limited to the following:

1. Manufacturer's name

2. Insulation material and thickness

3. Jacket

4. Adhesives

5. Fastening methods

6. Fitting materials

7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings

8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)

9. Other appropriate data

C. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.

D. Operation and Maintenance Data: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.06. DELIVERY, STORAGE and HANDLING

A. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 - PRODUCTS

2.01. GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02. MANUFACTURERS

A. Insulation:

1. Owens-Corning
2. Certainteed Corporation
3. Johns Manville Corporation
4. Knauf Corporation
5. Armstrong/Armacell (Armaflex)
6. RBX Industries/Rubatex
7. FOAMGLAS (Cellular Glass) by Pittsburgh Corning

B. Jackets:

1. Childers Products Company
2. PABCO
3. RPR Products, Inc.
4. John Mansfield Speedline

5. Foamglas

C. Coatings, Sealants, and Adhesives:

1. Foster

2. Childers

2.03. INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Piping Insulation Type P1: Glass-Fiber, Preformed Pipe Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory applied ASJ-SSL vapor barrier jacket with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Provide one of the following:

1. Owens Corning; Evolution Fiberglas Pipe Insulation.

2. Johns Manville; Micro-Lok Pipe Insulation.

3. Knauf; Earthwool 1000 degree Pipe Insulation.

F. Piping Insulation Type P2: Flexible Elastomeric Pipe Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Provide one of the following:

1. Armacell LLC; AP Armaflex

2. Aeroflex USA Inc; Aerocel

3. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Piping Insulation Type P3: Handicap Lavatory and Sink Piping Insulation Kit:

1. Handicap lavatory and sink drain piping, P-trap, cold and hot water assemblies and valves shall be insulated with fully molded insulation kit specifically designed for handicap lavatories and sinks. ADA conforming.

2. Material shall be 3/16" thick molded closed cell vinyl with nylon fasteners, white finish and be self-extinguishing per ASTM D635, with K value of 1.17 BTU/in./hr./sq. ft./deg. F.

H. Piping Insulation Type P4: Preformed Cellular Glass: Comply with ASTM C 585, ASTM C 450. Provide one of the following:

1. Pittsburgh Corning; Foamglas

2.04. FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe. Provide one of the following:

1. Foster Brand, Specialty Construction Brands, Inc; Mast-A-Fab.

2. Vimasco Corporation; Elastafab 894.

2.05. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Piping Jacket Type J1: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 40 mil thickness, roll stock ready for shop or field cutting and forming. Provide factory-fabricated fitting covers to match jacket. Provide one of the following

1. Johns Manville; Zeston.

2. Proto Corporation; LoSmoke

C. Piping Jacket Type J2: Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14. Provide factory-fabricated fitting covers or field fabricate covers only if factory-fabricated fitting covers are not available. Provide one of the following:

1. Provide Childers Brand Metal Jacketing Systems.

2. Provide shop fabricated smooth aluminum jacket 0.016".

2.06. TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.

2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.

2. Thickness: 6 mils.

3. Adhesion: 64 ounces force/inch in width.

4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf / inch in width.

2.07. INSULATION INSERTS

A. Provide insert between support shield and piping on piping 1 1/2" diameter or larger. Inserts shall be factory fabricated of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

1.	1 1/2" to 2 1/2" pipe size	10" long
2.	3" to 6" pipe size	12" long
3.	8" to 10" pipe size	16" long
4.	12" and over	22" long

2.08. PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048-inch stainless steel with twisted ends on maximum 12-inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

F. Adhesives: Compatible with insulation.

G. Banding:

1. Aluminum bands, 3/4" x 0.02 inches

2. Stainless Steel, 304, 3/4" by 0.02 inches

PART 3 - EXECUTION

3.01. PREPARATION

A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application. Insulating piping where condensate is occurring is unacceptable. Wet insulation is unacceptable and shall be removed and replaced before acceptance by the Owner.

B. Coordinate insulation installation with trade installing heat trace. Comply with requirements for heat tracing that apply to insulation.

C. Verify that piping has been tested for leakage before applying insulation.

3.02. GENERAL INSTALLATION REQUIREMENTS

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards, and shall conform to codes and ordinances of authorities having jurisdiction.

B. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.

C. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.

D. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.

E. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.

F. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

G. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

H. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

I. Install insulation with longitudinal seams at top and bottom of horizontal runs.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Keep insulation materials dry during application and finishing.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

P. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.

T. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.03. PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Section 15050 for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 15050."

3.04. GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket where concealed unions, check valve or piping specialties are insulated. Provide descriptive label at device under the insulation. For example, at each union stencil with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06. INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on below-ambient surfaces, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.07. FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.08. FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Do not field paint aluminum jackets.

3.09. PIPING SYSTEMS INSULATION SCHEDULE

PIPING SYSTEMS INSULATION TABLE T309.1									
SYSTEM	**LOCATION**			**PIPE SIZE**	**INSULATION**			**CARRYING HVAC CONDENSATE**	**NOTES**
					TYPE	**THICKNESS**	**JACKET TYPE**		
DOMESTIC COLD WATER	INTERIOR	CONDITIONED	CONCEALED	≤ 0.75"		0.5"	--	--	
				1.0" TO 2.0"		1.0"			
				≥ 2.5"		1.5"			
			EXPOSED	≤ 0.75"		0.5"	--	--	PAINT, COLOR PER ARCHITECT
				1.0" TO 2.0"		1.0"			
				≥ 2.5"		1.5"			
			EXPOSED	≤ 0.75"		0.5"	J1	--	IN EQUIPMENT ROOMS, FROM 0ft TO 7ft AFF
				1.0" TO 2.0"	**P1**	1.0"	J1		
				≥ 2.5"		1.5"	J1		
		UNCONDITIONED	CONCEALED OR EXPOSED	≤ 0.75"		1.0"	--	--	
				1.0" TO 2.0"		1.5"			
				≥ 2.5"		2.0"			
	EXTERIOR		CONCEALED OR EXPOSED	≤ 0.75"		1.0"	J2	--	
				1.0" TO 2.0"		1.5"	J2		
				≥ 2.5"		2.0"	J2		

PIPING SYSTEMS INSULATION TABLE T309.2									
SYSTEM	LOCATION			PIPE SIZE	INSULATION			CARRYING HVAC CONDENSATE	NOTES
					TYPE	THICKNESS	JACKET TYPE		
DOMESTIC HOT WATER	INTERIOR	CONDITIONED	CONCEALED	≤ 0.75"		0.5"			
				1.0" TO 2.0"		1.0"	--	--	
				≥ 2.5"		1.5"			
			EXPOSED	≤ 0.75"		0.5"			
				1.0" TO 2.0"		1.0"	--	--	PAINT, COLOR PER ARCHITECT
				≥ 2.5"		1.5"			
				≤ 0.75"		0.5"	J1		
				1.0" TO 2.0"	**P1**	1.0"	J1	--	IN EQUIPMENT ROOMS, FROM 0ft TO 7ft AFF
				≥ 2.5"		1.5"	J1		
		UNCONDITIONED	CONCEALED OR EXPOSED	≤ 0.75"		1.0"			
				1.0" TO 2.0"		1.5"	--	--	
				≥ 2.5"		2.0"			
	EXTERIOR		CONCEALED OR EXPOSED	≤ 0.75"		1.0"	J2		
				1.0" TO 2.0"		1.5"	J2	--	
				≥ 2.5"		2.0"	J2		

PIPING SYSTEMS INSULATION TABLE T309.3

SYSTEM	LOCATION			PIPE SIZE	INSULATION			CARRYING HVAC CONDENSATE	NOTES
					TYPE	THICKNESS	JACKET TYPE		
COOLING COIL CONDENSATE	INTERIOR	CONDITIONED OR UNCONDITIONED	CONCEALED	≤ 3.0"		0.5"	--	YES	
				≥ 4.0"	**P2**	0.75"			
			EXPOSED	≤ 3.0"		0.5"	J1	YES	
				≥ 4.0"		0.75"			
SANITARY SEWER	INTERIOR	UNCONDITIONED	EXPOSED OR CONCEALED	≤ 3.0"	**P2**	0.5"	--	YES	
				≥ 4.0"		0.75"			
STORM DRAIN	INTERIOR	UNCONDITIONED	EXPOSED OR CONCEALED	≤ 3.0"		0.5"	--	YES	INSULATE FROM CONDENSATE DISCHARGE POINT TO FLOOR.
				≥ 4.0"	**P2**	0.75"			
	INTERIOR	CONDITIONED OR UNCONDITIONED	EXPOSED OR CONCEALED	≤ 3.0"		0.5"	--	--	HORIZONTAL PIPING FROM DRAIN TO VERTICAL RISER.
				≥ 4.0"		0.75"			
	INTERIOR	CONDITIONED OR UNCONDITIONED	EXPOSED OR CONCEALED	≤ 3.0"		0.5"	J1	--	IN EQUIPMENT ROOMS, FROM 0ft TO 7ft AFF
				≥ 4.0"		0.75"			

PIPING SYSTEMS INSULATION TABLE T309.4									
SYSTEM	**LOCATION**			**PIPE SIZE**	**INSULATION**			**CARRYING HVAC CONDENSATE**	**NOTES**
					TYPE	**THICKNESS**	**JACKET TYPE**		
WATER AND DRAIN	INTERIOR	--	EXPOSED	--	**P3**	--	--	--	AT HANDICAP LAVATORIES

END OF SECTION 22 0086

SECTION 22 0090

SUPPORTS, HANGERS AND ANCHORS

PART 1 GENERAL

1.01. WORK INCLUDED

A. Inserts, Anchors, and Upper Attachments

B. Pipe Hangers, Rods, Supports, and Accessories

C. Fabricated Steel Support

1.02. QUALITY ASSURANCE

A. Design of pipe supporting elements shall be in accordance with ANSI B31.1

B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards:

1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.

2. SP-69 Pipe Hangers and Supports: Selection and Application.

3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.

C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications and hot galvanized for exterior applications.

D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.

E. Welding of steel members shall be in accordance with AWS D1.1.

F. Steel supports for ducts, pipe anchors, pipe guides, and piping supported from below shall be fabricated in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. If required, the Contractor shall include the cost of the services of a structural engineer to design or review the system.

1.03. APPLICABLE PUBLICATIONS

A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced by the basic designation only.

1. American Institute of Steel Construction (AISC)

2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)

4. American Welding Society (AWS)

5. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

6. National Fire Protection Agency (NFPA)

7. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

1.04. SUBMITTALS

A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.

B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

C. Provide shop drawings for fabricated steel supports.

PART 2 PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS

A. Inserts, Anchors, and Upper Attachments:

1. Anvil International, Inc.

2. Carpenter Paterson, Inc.

3. Cooper B-Line, Inc.

4. Elcen Metal Products

5. Hilti

6. Unistrut

7. ITW Red Head

B. Pipe Hangers, Rods, Supports and Accessories:

1. Anvil International, Inc.

2. Carpenter Paterson, Inc.

3. Cooper B-Line, Inc.

4. Elcen Metal Products

5. Hilti

6. Unistrut

C. Fabricated Steel Support: As indicated on Drawings.

2.02. DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions. Provide 4-to-1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction, and installation of pipe hangers, supports, guides, restraints, and anchors:

1. ASME B31.3.

2. MSS SP-58 and MSS SP-69.

3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation pipe hangers, supports, guides, restraints and anchors:

1. ASME B31.1

2. MSS SP-58 and MSS SP-69.

F. Check all physical clearances between piping, support system, and structure. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.

H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.

I. Fabricated Steel Supports: As detailed on the drawings.

2.03. INSERTS AND ANCHORS

A. Inserts: MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable.

B. Anchors: Steel shell and expander plug, snap off end fastener

2.04. HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Select size of hangers and supports to exactly fit pipe size for bare piping, and around piping

insulation with saddle or shield for insulated piping.

B. For suspension of non-insulated or insulated stationary pipe lines: Adjustable steel clevices, MSS Type I.

C. For suspension of non-insulated stationary pipe lines: Adjustable band hangers, MSS Type 7 or 9; or split pipe rings, MSS Type II.

D. For support of piping where horizontal movement due to expansion and contraction may occur, and where a low coefficient of friction is desired: Pipe slides and slide plates, MSS Type 35, including guided plate mounted on a concrete pedestal or structural steel support.

E. For support from floor stanchion, using floor flange to secure stanchion to floor: Adjustable pipe stanchion saddles, MSS Type 37 or 38, including steel pipe base support and cast-iron floor flange.

F. For suspension of pipe from two (2) rods where longitudinal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.

G. For suspension of pipe from a single rod where horizontal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.

H. For support of pipe from a single rod where vertical adjustment is not necessary: Pipe roll stands, MSS Type 45.

I. For support of pipe where small horizontal movement due to expansion and contraction may occur, but vertical adjustment is not necessary: Pipe rolls and plates, MSS Type 45.

J. For support of pipe lines where vertical and lateral adjustment during installation may be required in addition to provision for expansion and contraction: Adjustment pipe rolls stands, MSS Type 46.

2.05. VERTICAL PIPING CLAMPS

A. Select size of vertical piping clamps to exactly fit size of bare pipe.

B. For support and steadying of pipe risers: Two-bolt riser clamps, MSS Type 8 or 42.

2.06. HANGER ROD ATTACHMENTS

A. Select size of hanger rod attachments to suit hanger rods.

B. For adjustment up to six (6) inches for heavy loads: Steel turnbuckles, MSS Type 13.

C. For use on high temperature piping installations: Steel clevices, MSS Type 14.

D. For use with split pipe rings, MSS Type II: Swivel turnbuckles, MSS Type15.

E. For attaching hanger rod to various types of building attachments: Malleable iron sockets, MSS Type 16 or 17.

F. Rods:

1. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

Copper Tube, Plastic	Steel, Cast Iron		
Pipe Size (Copper, Plastic)	Pipe Size (Steel, Cast Iron)	Rod Size	Max. Equip. Load
1/4" to 2"	1/4" to 2"	3/8"	730 lbs.
2-1/2" to 4"	2-1/2" to 3"	1/2"	1,350 lbs.
6"	4"	5/8"	2,160 lbs.
8" to 12"	6"	3/4"	3,230 lbs.
14"	8" to 12"	7/8"	4,480 lbs.
16"	14" to 16"	1"	5,900 lbs.
18" to 20"	18" to 20"	1-1/4"	9,500 lbs.
22" to 42"	22" to 42"	1-1/2"	13,800 lbs.

2. Rods may be reduced one size for double rod hangers with 3/8" minimum diameter, or when other paragraphs require a minimum of 2 hangers per section, provided the minimum diameter of 3/8" is maintained.

G. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18.

H. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19.

I. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 20 or 27.

J. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21.

K. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22.

L. For attachment to structural shapes: C-clamps, MSS Type 23.

M. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beams clamps, MSS Type 25.

N. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut, MSS Type 28 or 29.

O. Steel brackets, for indicated loading:

1. Light duty, 750 pounds, MSS Type 31.

2. Medium duty, 1,500 pounds, MSS Type 32.

3. Heavy duty, 3,000 pounds, MSS Type 33.

P. For use on sides of steel beams: Side beam brackets, MSS Type 34.

2.07. SPRING HANGERS AND SUPPORTS

A. Select spring hangers and supports to suit pipe size and loading.

B. For control of piping movement: Restraint control devices, MSS Type 47.

C. For light loads where vertical movement does not exceed 1-1/4 inch: Springs cushion hangers, MSS Type 48.

D. For equipping Type 41 roll hanger with springs: Spring cushion roll hangers, MSS Type 49.

E. For retardation of sway or thermal expansion in piping systems: Spring way braces, MSS Type 50.

F. For absorbing expansion and contraction of piping system from hanger: Variable spring hangers, MSS Type 51; preset to indicated load and limit variability factor to 25%.

G. For absorbing expansion and contraction of piping system from base support: Variable spring base supports, MSS Type 52; preset to indicated load and limit variability factor to 25%; include flange.

H. For absorbing expansion and contraction of piping system from trapeze support: Variable spring trapeze hangers, MSS Type 53; preset to indicated load and limit variability factor to 25%.

I. Constant supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.

1. Horizontal Type: MSS Type 54.

2. Vertical Type: MSS Type 55.

3. Trapeze Type: MSS Type 56.

2.08. SUPPLEMENTARY SUPPORTS

A. Where support spacing is more frequent than distance between structural members, provide steel angles, channels or beams sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.

B. Where deflection of center of trapeze support exceeds 1/240 of distance between hanger rods, provide additional hanger rods.

C. Where multiple risers are supported within shafts, provide steel angles, channels or beams, sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.

2.09. ACCESSORIES

A. Protective Shields, MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation.

B. Protective Saddles, MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation.

C. Steel Turnbuckle, MSS Type 13: Forged steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size.

D. Steel Clevis, MSS Type 1: Forged steel, galvanized finish with steel pin and cotter pin. Rated for

a minimum of 730 lbs. at 3/8" size.

E. Weldless Eye Nut, MSS Type 17: Forges steel, galvanized finish. Rated for a minimum of 730 lbs. at 3/8" size.

2.10. PIPE INSULATION HANGER SHIELDS

A. Where hangers are placed outside the jackets of pipe insulation, provide shields equal to "Thermal Hanger Shields" as manufactured by Pipe Shields, Inc. or equivalent by Elcen Metal Products Company.

B. Shields shall consist of a 360-degree insert of high-density, 100 psi, waterproof calcium silicate, encased in a 360-degree galvanized sheet steel shield. Insert shall be same thickness as adjoining pipe insulation, and shall extend 1 inch beyond sheet metal shield in each direction on cold lines. Shield lengths and minimum sheet metal gauges shall be as directed below:

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2" to 1-1/2"	4"	26
2" to 6"	6"	20
8" to 10"	9"	16
12" to 18"	12"	16
20" & Larger	18"	16

C. Shields shall be Model CS-CW, except for pipe roller applications: then provide Model CSX-CW.

D. At the Contractor's option, shop-fabricated galvanized metal shields may be provided based on approved shop drawings. Length and gauge of sheet metal shall be as specified above.

E. For all insulated piping 4” and larger, provide insulation insert at a minimum of 12” long. Insert shall extend a minimum of one inch beyond shield. Insulation inserts shall be minimum 12” long section of foam glass insulation.

2.11. METAL FRAMING: Provide products compliant with NEMA ML-1.

2.12. STEEL PLATES, SHAPES AND BARS: Provide products compliant with ANSI/ASTM A-36.

2.13. PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base, with a two-section guiding spider bolted tight to pipe or as shown on Drawings. Size guides and spiders to clear pipe, cylinder and insulation, if any. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

A. Where applicable, install in accordance with the manufacturer's written installation instructions.

B. Where supports are in contact with copper pipe, provide copper plated support.

C. Where supports are in contact with glass, aluminum or brass pipe, provide plastic coating on supports.

D. Interior hangers, supports, including attachments, that are plain steel shall be primed and painted.

E. Hangers and supports, including attachments, exposed to weather or located in utility tunnels or accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication.

F. Fabricated steel supports exposed to weather or located in utility tunnels and accessible utility trenches or subject to spillage shall be primed and painted. Cut, welded, drilled or otherwise damaged surfaces of coating shall be repaired.

3.02. PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including but not limited to proper placement of inserts, anchors and other building structural attachments.

3.03. INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure in compliance with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together in trapeze-type hangers where possible. Install supports with maximum spacing as specified in this Section. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for small diameter pipe. Do no use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire protection water piping independently of other piping

D. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.

E. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate und upper attachment. Rod nuts shall be securely locked in place.

F. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.

G. Hangers shall be fabricated to permit adequate adjustment after erection while still supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.

H. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.

I. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.

J. Provide protective shields on all piping required to be insulated.

K. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.

L. Provide turnbuckles on all hangers that require leveling or aligning.

M. Provide steel clevis where detailed and/or required.

N. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.

O. Supports

1. Provide additional supports at:

a. Changes in direction.

b. Branch piping and runouts over 5 feet.

c. Concentrated loads due to valves, strainers and similar items.

d. At valves 4 inches and larger in horizontal piping.

e. Support piping on each side of valve.

f. Brace hubless piping to prevent horizontal and vertical movement.

g. Where number of grooved couplings exceeds 3 between supports or provide continuous steel between supports.

2. Sanitary waste and vent, roof drains per UPC Section 316: Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.

3. Other piping support spacing shall be as scheduled on Drawing or as required by referenced standard.

3.04. HANGER SPACING

A. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturer's written installation instruction, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING TABLE

1. Steel Pipe (Schedule 40 & 80):
Up to 1" ..... 7 ft. on center
1-1/4" and greater ..... 10 ft. on center

2. Copper Pipe (Types L, K and M):
Up to 1" size: ..... 5 ft. on center
1-1/4" to 2-1/2" ..... 7 ft. on center
3" and larger ..... 10 ft. on center

3. Ductile Iron and Cast Iron: Two hangers per section length.

4. Polyvinyl Chloride (PVC):
Up to 1-1/2" ..... 3 ft. on center
2" to 4" ..... 4 ft. on center
5" to 8" ..... 5 ft. on center

10" and larger..... 6 ft. on center

5. Sprinkler and Standpipe: Pipe hangers to be as per NFPA-13 and NFPA-14 standards.

B. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.

3.05. ATTACHMENT TO STRUCTURE

A. For plain steel devices, prime and paint.

B. Adjust attachment location for proper alignment and no more than 4 degrees offset from a perpendicular alignment.

C. If proper alignment cannot be achieved from the existing building structure, provide a trapeze type support sized to handle the design load with a minimum safety factor of 5.

3.06. INSERTS

A. Contractor shall have inserts at site and dimensional location drawings ready at the beginning of the involved concrete work.

B. Install inserts by securing to concrete forms and inserting reinforcing rod through the opening provided in the insert in accordance with shop drawings.

C. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.

3.07. INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B-31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bards to piping and to structure. Comply with ANSI B-31, with AWS standards, and with the Details shown on the drawings.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required, accommodating both expansion and contraction of piping.

E. Size anchor shell length to assure a minimum of 1" solid concrete remaining from shell and to concrete face.

3.08. INSTALLATION OF TRAPEZES OR PIPE RACKS

A. Light/Medium Duty: Assemble from standard manufactured metal framing systems, in accordance with manufacturer's recommendations.

B. Heavy Duty: Fabricate from structural steel shapes selected for loads required. Weld steel in accordance with AWS standards.

3.09. AUXILIARY STEEL

A. Furnish all miscellaneous structural members necessary to hang or support ductwork, piping, and mechanical equipment.

B. Notify Engineer of any adjustment necessary in main structural system for proper support of major equipment.

C. Fabricated Steel Supports: Steel for supports shall be saw cut, with sharp edges ground smooth. After fabrication, remove all foreign material, including welding slag and spatter, and leave ready for painting.

END OF SECTION

SECTION 22 01 10

BASIC VALVES

PART 1 - GENERAL

1.01 Valves specified in this section are for general use. See specifications for specific systems and special valves.

1.02 SUBMITTALS

A. Product Data: Provide for each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories. Provide valve schedule with product data listing valves used for each service application.

1.03 QUALITY ASSURANCE:

A. Single Source Responsibility: Where possible valves shall be by the same manufacturer.

B. MSS Standard Practices: Comply with the MSS standards for valves specified.

C. ASME: Comply with ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

D. NSF: Comply with NSF 61 for valve materials for potable water service.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Preparation for Transport:

1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.

2. Protect valve ends against mechanical damage to threads, flange faces, and weld end preps.

3. Set valves in best position for handling. Globe and gate valves shall be closed to prevent rattling; plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.

B. Storage:

1. Do not remove valve end protectors unless necessary for inspection; reinstall for storage.

2. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is

necessary, support valves off the ground or pavement and protect in watertight enclosures.

C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering valves which may be incorporated in the work include the following. For majority of valves, Milwaukee has been used as basis of design. Equal valves of other manufacturers may be submitted without substitution requests.

1. APCO
2. Apollo
3. CPV
4. Crane
5. DeZurick
6. Grinnell
7. Hammond
8. Jamesbury
9. Jenkins
10. Keflex
11. Metraflex
12. Milwaukee
13. Mueller
14. Nibco
15. Nordstrom
16. Powell
17. Stockham
18. Walworth
19. Watts

2.02 VALVE FEATURES:

A. Valve Design: Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: Not less than indicated and required to suit system pressures and temperatures.

C. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

D. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.

2. Lever handle on quarter-turn valves 4 inch and smaller, except for plug valves. Provide one wrench for every 10 plug valves.

3. Chain-wheel operators for valves 2-1/2 inch and larger installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.

4. Gear drive operators on quarter-turn valves 6 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Provide bypass and drain connections required by manufacturer and as indicated on the drawings.

G. End Connections: As specified in the individual valve specifications.

1. Threads: Comply with ANSI B1.20.1.

2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

H. Valves for Domestic Hot Water and Cold Water.

1. Gate Valves:

a. 2 inch and Smaller: Class 125, body and bonnet of ASTM B62 cast bronze, threaded ends, solid disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #105.

b. 2-1/2 Inch and Larger: Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and packing gland assembly. Milwaukee #F-2885A.

2. Ball Valves:

a. Valves 2 Inches and Smaller: Threaded ends, rated for 400 psi WOG pressure; 3 piece construction, bronze body conforming to ASTM B 62, full port, chrome-plated brass ball, replaceable “Teflon” or “TFE” seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide insulator type handle for chilled water and condensate drain. Milwaukee BA-300.

3. Plug Valves:

a. 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends. Lunkenheimer 454.

b. 2-1/2 Inch and Larger: 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends. Nordstrom 143.

4. Globe Valves:

a. 2 Inch and Smaller: Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #502T.

b. 2-1/2 Inch and Larger: Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and packing gland assembly. Milwaukee F2981A.

5. Butterfly Valves: 2-1/2 Inch and Larger: 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with nickel-plated ductile iron disc (except valves installed in condenser water piping which shall have aluminum bronze disc), stainless steel stem, and EPDM O-ring stem seals. Valves shall have gear operator with extended wheel handle and position indicator. Valves shall be lug type, drilled and tapped. Valves shall be suitable for dead end service, Class I, tight shut off. Milwaukee CL 223E.

6. Check Valves:

a. Swing Check Valves:

1. 2 Inch and Smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded ends. Valve shall be capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications may be used where pressure requires or Class 125 are not available. Milwaukee #509.

2. 2-1/2 Inch and Larger: Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line. Milwaukee #F2974A.

b. Spring Loaded (Non-Slam Check Valves for Pumps: Valves shall be iron body, globe typed silent check valves, bronze mounted, stainless steel spring with flanged (125-pounds drilling) end connections for installation between ASA 150 lbs. flat face steel slip on weld flanges. Valves shall be comparable to Mueller #105-AP, APCO Series 600, CPV Globe Type Silent Check Valve, Kelflex K-Check Silent Check Valve, or Metraflex Globe Style Silent Check Valve.

PART 3 – EXECUTION

3.01 EXAMINATION:

A. Examine piping systems for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior, threads, and flanges for cleanliness, and signs of damage or corrosion. Remove all shipping materials.

C. Actuate valve through an open-close cycle to determine if operation is proper.

D. Examine the piping for cleanliness and alignment.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gaskets are of proper size, that material composition is suitable for service, and are free from defect.

F. Do not attempt to repair a defective valve. Replace all defective valves with new valves.

3.02 VALVE SELECTION:

A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2 Inch and Smaller: Threaded ends.

2. Steel Pipe Sizes 2 Inch and Smaller: Threaded ends.

3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged.

B. Ball valves may be used in lieu of gate valves for piping 2” and smaller except in steam and condensate return systems. Use gate valves for piping 2-1/2” and larger in size.

3.03 VALVE INSTALLATIONS:

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

B. Valves shall be located in an accessible position or made accessible through access panel.

C. Where several valves are related as to function, they shall be grouped in a battery.

D. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shutdown. Unions are not required on flanged devices.

E. Install a valved bypass around each pressure reducing valve using a globe valve for throttling.

F. Installation of check valves:

1. Swing Check Valves: Install in horizontal position with hinge pin level.

2. Wafer Check Valves: Install between two flanges in horizontal or vertical position.

3. Lift Check Valves: Install in piping with stem upright and plumb.

G. No valve shall be installed with stem below horizontal position without prior approval.

H. Provide special handles or operators as required or as indicated on the drawings.

I. Valves specified under specific systems shall take precedence over those as specified herein.

J. Valves in copper pipe shall have threaded ends (except where size dictates flanged ends), use copper to MPT adapters as required.

K. Provide non-slam type check valves at pumps.

3.04 FIELD QUALITY CONTROL:

A. Testing: After piping systems have been tested and put into service but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

3.05 ADJUSTING AND CLEANING:

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

3.06 VALVE BOXES

A. Valves located below slabs or grade shall be housed in cast iron boxes and covers. Covers shall be properly identified as to service controlled by the valves.

B. Furnish Owner with proper key or valve operator extension.

END OF SECTION

SECTION 22 0120

PIPING SPECIALTIES

PART 1 - GENERAL

1.01 Specific requirements for specialties indicated on drawings or in other sections of these specifications shall take precedence over items as specified in this section.

1.02 Submit brochures and other supportive product data for all items.

1.03 Ranges for thermometer, gages, or similar instruments shall be selected so that normal operation will be near center of scale. Range shall not be longer than required. Use compound gage where vacuum may be encountered.

1.04 Combination instruments for thermometers and gages will not be acceptable.

PART 2 - PRODUCTS

2.01 THERMOMETERS:

A. Thermometers shall be equal to Trerice Series BX9, 9-inch, adjustable type. Stem length shall be a minimum of 3/4 of the pipe diameter, plus well extension length. Use 12-inch stem length in tanks.

B. Provide brass wells and stems.

2.02 THERMOMETER WELLS:

A. Provide wells with extension neck for insulated piping.

B. Wells shall be Trerice Series 138 type.

C. Test wells to be Trerice Series 169 type with cap and chain.

2.03 GAGES:

A. Gages shall be equal to Trerice Series 800, 3-1/2-inch size.

B. Provide snubber and cock for each gage.

C. Provide coil syphon and cock for each steam gage.

D. Gauges shall be liquid filled.

2.04 TEST PLUGS:

A. Test plugs shall be equal to Peterson Engineering Company #110, 1/4" size, with brass body, dust cap and "Nordel" valve core material.

2.05 STRAINER:

A. "Y" Type (Haywood, Muessco, or Sarco):

1. 1/2" through 2": Haywood Model 80, bronze, 300 lb. WP, 500 lb. WOG or Haywood Model 80 iron body, 250 lb. WP, 900 lb. WOG. Provide Monel or stainless steel screen, blow-off outlet, screwed ends.

2. 2-1/2" through 12": Haywood Model 80 iron body, 125 lb. SWP, 175 lb. WOG, brass screen, blow-off outlet, flanged ends.

B. Screens - Steam:

1. Monel or stainless steel.

2. Perforations - .057 diameter, 144 per sq. in.

C. Screens - Water:

1. Brass.

2. Perforations: Up to 2" - 1/10" diameter, 49 per sq. in.; 2-1/2" to 4" - 1/8" diameter, 32 per sq. in.; 5" up - 1/4" diameter, 8 per sq. in.

2.06 FLEXIBLE CONNECTORS:

A. Pumps and Chillers: Bellows Type 3, equal to Keflex #151-TR-1250, with 150 lb. flanges and tie rods. 150 psig maximum working pressure. 304 stainless steel. Bellows welded to flanges. Tie rods with chatter proof spacers. Unit rated at 800°F.

B. Coils, Valves, And Miscellaneous Equipment: Stainless steel braided hose type.

2.07 ELECTRICAL HEAT TAPE:

A. Heat tape shall be equal to Emerson Chromalox.

B. Electrical heat tape shall be installed where indicated on the drawings to prevent pipe freezing.

C. Heat tape shall be approved for use in hazardous areas as indicated and U.L. listed.

2.08 CALIBRATED BALANCE VALVE:

A. For valves 2” and smaller:

1. Bronze body.

2. Ball or globe type.

3. 250 psig at 250° F rating.

4. Threaded ends.

5. Calibrated orifice or venturi.

6. Meter connections with integral seals.

7. Memory stop.

B. For valves 2-1/2” and larger:

1. Iron or steel body.

2. Ball or globe type.

3. 125 psig at 250° F rating.

4. Flanged connection.

5. Calibrated orifice or venturi.

6. Meter connections with integral seals.

7. Memory stop.

C. Acceptable manufacturers:

1. Flow Design

2. Bell and Gossett

3. Taco

4. Armstrong

5. Nibco

PART 3 - EXECUTION

3.01 GAGES, THERMOMETERS, AND TEST PLUGS:

A. Provide thermometers in inlet and outlet piping of chillers, boilers, water heaters, air handling unit coils, and elsewhere as indicated on the drawings.

B. Provide gages on inlet and outlet piping of all pumps, except domestic hot water circulators, steam gages on boiler headers, and elsewhere as indicated on the drawings.

C. Arrange thermometers and gages so they might be read standing in a normal position on the floor.

D. Provide test plugs on inlet and outlet piping of all heat exchanger equipment not equipped with thermometers. This includes all heating and cooling coils in air handling units, fan coil units, and other terminal devices with coils.

E. Locate gages, thermometers, and test plugs as close as possible to equipment being monitored.

3.02 FLEXIBLE PIPE CONNECTORS:

A. Install flexible pipe connectors where indicated on the drawings.

B. Install connectors as close as possible to equipment inlets and outlets.

C. Support pipe work independently of flexible connectors. Brace and anchor piping as required to prevent movement of piping ends of flexible connectors and align all equipment, pipe work, and flanges so that no flexible connectors shall be misaligned and/or stressed beyond the manufacturer's recommended maximum limits.

3.03 HEAT TAPE:

A. Install the heat tape below the pipe insulation in a uniform distribution to obtain the watts/linear foot as indicated.

B. Wiring installation shall be done in accordance with the NEC and the manufacturer's requirements.

C. Power for heat tape shall come from an emergency circuit. If no emergency circuit is available, the power shall come from a dedicated circuit, marked heat tape in the panel.

D. Unless indicated otherwise on the plans, install heat tape with a minimum capacity of 5 watts/foot.

E. Heat tape shall be thermostatically controlled and shall be preset to energize before freezing. An indicator light shall energize when the heat tape is "on."

END OF SECTION

SECTION 220140

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SCOPE

A. This section contains specifications for pipe and pipe fittings.

1.02 REFERENCE STANDARDS

A. ANSI A21.4

B. ANSI A21.11

C. ANSI A21.51

D. ANSI B16.3 Malleable Iron Threaded Fittings

E. ANSI B16.4 Cast Iron Threaded Fittings

F. ANSI B16.5 Pipe Flanges and Flanged Fittings

G. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

H. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings–DWV

I. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

J. ASTM A105 Forgings, Carbon Steel, for Piping Components

K. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

L. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

M. ASTM A536 Ductile Iron Castings

N. ASTM B32 Solder Metal

O. ASTM B88 Seamless Copper Water Tube

P. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

Q. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

R. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

S. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

T. ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

U. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

V. ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

W. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

X. ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings

Y. ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

Z. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

AA. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

BB. ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials

CC. ASTM D4101 Propylene Plastic Injection and Extrusion Materials

DD. ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

EE. ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40

FF. ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80

GG. ASTM F493 Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings

HH. ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

II. ASTM F1476 Performance of Gasketed Mechanical Couplings for Use in Piping Applications

JJ. AWS A5.8 Brazing Filler Metal

KK. AWWA C104 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

LL. AWWA C105 Polyethylene Encasement for Ductile Iron Piping for Water

MM. AWWA C110 Ductile Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids

NN. AWWA C111 Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings

OO. AWWA C151 Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids

PP. AWWA C153 Ductile Iron Compact Fittings, 3 In. Through 48 In., for Water and Other Liquids

QQ. AWWA C600 Installation of Ductile Iron Water Mains and Their Appurtenances

RR. AWWA C606 Grooved and Shouldered Joints

SS. AWWA C651 Disinfecting Water Mains

TT. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

1.03 SUBMITTALS

A. Provide schedule indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.

B. Provide statement from manufacturer that pipe furnished meets the ASTM or specification contained in this section.

C. Grooved joint couplings and fittings shall be shown on product submittals, and shall be specifically identified with the applicable style or series designation.

1.04 QUALITY ASSURANCE

A. Pipe materials shall bear label, stamp, or other markings of specific testing agency.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.06 SYSTEM CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or AWWA specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system.

C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

PART 2 - PRODUCTS

2.01 DOMESTIC WATER

A. ABOVE GROUND:

1. Type L copper water tube, H (drawn) temper, ASTM B88;

a. Solder joint; wrought copper ASME B16.22 pressure fittings; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.

2. (Water Service Entrance) Ductile iron pipe, thickness Class 53, AWWA C151/C115; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical grooved cement mortar lined fittings and couplings on cut grooved pipe, Class 350 12" and below, Class 250 above 12", AWWA C606; ductile iron or gray iron flanged cement mortar lined fittings, Class 250, AWWA C110; rubber gasket joints with non-toxic gasket lubricant, AWWA C111.

B. BELOW GROUND 2-1/2" AND SMALLER: Type K copper water tube, O (annealed) temper, ASTM B88; with cast copper pressure fittings, ASME B16.18; wrought copper pressure fittings, ASME B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast copper flared pressure fittings, ASME B16.26.

C. BELOW GROUND 3" AND LARGER:

1. Ductile iron pipe, mechanical or push on joint, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron or gray iron mechanical joint cement mortar lined fittings, Class 250, AWWA C110; ductile iron mechanical joint compact fittings, Class 350, AWWA C153; rubber gasket joints with non-toxic gasket lubricant, AWWA C111. Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.

D. THRUST RESTRAINTS FOR UNDERGROUND PIPING: Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference, low alloy steel T-bolts and UL listing or Factory Mutual approval. For PVC pipe joint bells, use epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it is applied on.

2.02 DIELECTRIC UNIONS AND FLANGES

A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

B. Victaulic Series 47, dielectric waterway fittings to 8”, threaded or grooved ends, electroplated steel or ductile iron casing, with inert thermoplastic lining having a pressure rating to 300 psig at 230 degrees F.

2.03 UNIONS AND FLANGES

A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.

B. 2" AND SMALLER STEEL:

1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.

2. 2" AND SMALLER COPPER: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

C. 2-1/2" AND LARGER STEEL: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full-face gaskets. Use ANSI B16.1 flat face flanges with full face Teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be Teflon type.

D. 2-1/2" AND LARGER COPPER: ANSI B15.24 Class 150 cast bronze flanges with full face Teflon gaskets.

E. Fittings used on galvanized steel pipe to be ductile iron A536, with galvanized finish, ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM A536; conforming to requirements of AWWA C110/C153 and AWWA C606. Fittings used on copper tube to be copper tube dimensioned wrought copper ANSI B16.22 or cast bronze ASNI B16.18. Fittings used on stainless steel shall be ASTM A403 or factory fabricated ASTM A312.

F. Gaskets to be EPDM, ASTM D1330. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat treated carbon track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633, or stainless steel ASTM F593.

G. Gaskets used on potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service.

H. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used. Victaulic Style 741 (steel pipe), 341 (AWWA ductile iron pipe) or 641 (copper tubing).

PART 3 - EXECUTION

3.01 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.02 INSTALLATION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping. All piping shall be concealed in areas with ceilings.

B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for installation of insulation, access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

1. For water systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the Engineer). Where expansion loops are required, use Victaulic Style 77 couplings on the loops.

G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Install valves at height to access with step ladder. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.03 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess

solder and flux from joint.

B. Grooved joints for copper tubing shall be made at copper tube dimensions. (Flaring of tube ends to accommodate alternate sized couplings is not permitted).

3.04 THREADED PIPE JOINTS

A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.05 MECHANICAL JOINT PIPE CONNECTIONS

A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

3.06 PUSH-ON GASKETED PIPE CONNECTIONS

A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.07 DOMESTIC WATER

A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

B. Install exterior water piping below predicted frost level in accordance with State Plumbing Code, but in no case less than 3' bury depth to top of pipe. Maintain minimum of 8' horizontal distance between 2-1/2" and larger water piping and sanitary sewer piping. Maintain minimum of 30" horizontal and 12" vertical distance, water on top, between 2" and smaller water piping and sanitary sewer piping. Where water piping crosses a sanitary sewer, provide minimum 18" vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10' from sewer in both directions.

C. Provide thrust restraints for 3" and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.

D. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

E. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a solution of water and chlorine containing at least 50 parts per million of chlorine and allow to stand for 24 hours. Alternately a solution containing at least 200 parts per million of chlorine may be used and allowed to stand for 3 hours. Flush system with potable water until chlorine concentration is no higher than source water level.

F. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall be representative of the system size and configuration and are subject to approval by Engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.

3.08 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions, waterway fittings, or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.09 UNIONS AND FLANGES

A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

B. Union and flanges for disconnect and servicing area not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).

3.10 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

F. Entire test must be witnessed by the Owner's representative. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Below Ground Domestic Water	Water	N/A	200 psig 2 Hour
Above Ground Domestic Water	Water	N/A	100 psig 8 Hour
Above Ground Non-Potable Water	Water	N/A	100 psig 8 Hour
Below Ground Non-Potable Water	Water	N/A	100 psig 8 Hour

END OF SECTION

SECTION 22150

SANITARY WASTE AND VENT

PART 1 - GENERAL

1.01 SCOPE

A. This section contains specifications for sanitary waste and vent plumbing pipe and pipe fittings.

1.02 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A234 Pipe Fittings-Wrought Carbon Steel & Alloy Steel for Moderate & Elevated Temperatures

ASTM A861 High Silicon Iron Pipe and Fittings

ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B32 Solder Metal

ASTM B88 Seamless Copper Water Tube

ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM B306 Copper Drainage Tube (DWV)

ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials

ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM D4101 Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials

ASTM F2618 Standard Specification for Chlorinated Poly Vinyl Chloride (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.

AWS A5.8 Brazing Filler Metal

PART 2 - PRODUCTS

2.01 SANITARY WASTE AND VENT

A. INTERIOR ABOVE GROUND:

1. Hubless cast iron soil pipe and fittings, ASTM A888; ASTM A74. Provide heavy duty, shielded stainless steel bands and tightening devices with ASTM Standard C564 rubber sleeve, ANACO/HUSKY SD 4000 / IDEAL TRIDON Heavy Duty.

2. Solid Wall SCH 40 PVC pipe and fittings.

3. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.

B. INTERIOR BELOW GROUND:

1. Solid Wall SCH 40 PVC or Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.

2. For areas with acidic soil, eg Fayetteville, Solid Wall SCH 40 PVC or Epoxy Coated Cast Iron equal to Charlotte 'Edge'.

C. EXTERIOR BELOW GROUND 15" AND SMALLER:

1. Solid Wall SCH 40 PVC or Cast-iron soil pipe and fittings, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.

2. For areas with acidic soil, eg Fayetteville, Solid Wall SCH 40 PVC or Epoxy Coated Cast Iron equal to Charlotte 'Edge'.

2.02 SUBMITTALS

A. Provide schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.

B. Provide statement from manufacturer that pipe furnished meets the ASTM specification contained in this section.

2.03 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specific testing agencies.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

2.04 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

2.05 SYSTEM CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

PART 3 - EXECUTION

3.01 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer’s recommendations and recognized industry practices.

3.02 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 INSTALLATION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for installation of insulation, access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

H. Install all valves and piping specialties, including items furnished by others, as specified

and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.05 THREADED PIPE JOINTS

A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.06 MECHANICAL HUBLESS PIPE CONNECTIONS

A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturer's recommended torque.

3.07 PUSH-ON GASKETED PIPE CONNECTIONS

A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.08 SANITARY WASTE AND VENT

A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot for 2” and smaller piping and 1/8" per foot for piping 3" and larger.

B. Install exterior piping below predicted frost level and not less than 3 feet bury depth to top of pipe wherever possible.

C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

3.09 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

F. Entire test must be witnessed by the local authority having jurisdiction. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Sanitary Waste & Vent	Water	N/A	10’ Water 2 Hour

END OF SECTION

SECTION 220155

STORM DRAIN PIPING

PART 1 - GENERAL

1.01 SCOPE

A. This section contains specifications for storm drain piping.

1.02 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

STM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A861 High Silicon Iron Pipe and Fittings

ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B32 Solder Metal

ASTM B88 Seamless Copper Water Tube

ASTM B306 Copper Drainage Tube (DWV)

ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

ASTM C443 Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM D4101 Propylene Plastic Injection and Extrusion Materials

ASTM F405 Corrugated Polyethylene (PE) Tubing and Fittings

ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40

ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80

ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

1.03 SUBMITTALS

A. Provide schedule indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.

B. Statement from manufacturer that pipe furnished meets the ASTM or AWWA specification contained in this section.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specific testing agency.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.06 SYSTEM CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or AWWA specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system.

C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

PART 2 - PRODUCTS

2.01 STORM AND CLEARWATER WASTE

A. Interior Above Ground:

1. Hubless cast iron soil pipe and fittings, ASTM A888; ASTM A74. Provide heavy duty, shielded stainless steel bands and tightening devices with ASTM Standard C564 rubber sleeve, ANACO/HUSKY SD 4000 / IDEAL TRIDON Heavy Duty.

2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813;

copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

3. Copper drainage tube (DWV), ASTM B306; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

B. Interior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.

2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

C. Exterior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene compression rubber gaskets, ASTM C564.

2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

3. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM D2564; or integral bell and flexible elastomeric seal, ASTM D3212.

PART 3 - EXECUTION

3.01 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer’s recommendations and recognized industry practices.

3.02 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 INSTALLATION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult

drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for installation of insulation, access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.05 THREADED PIPE JOINTS

A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.06 SOLVENT WELDED PIPE JOINTS

A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply

primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Architect/Engineer.

C. Solvent cement and primer shall be compliant with California South Coast Air Quality Management District (SCAQMD) Rule 1168 and Ozone Transport Commission (OTC) regulations for Volatile Organic Compound emissions levels.

3.07 MECHANICAL HUBLESS PIPE CONNECTIONS

A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.08 PUSH ON GASKETED PIPE CONNECTIONS

A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.09 STORM AND CLEARWATER WASTE

A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot where possible and in no case less than 1/16" per foot for piping 3" and larger.

B. Install exterior piping below predicted frost level and not less than 3 feet bury depth to top of pipe wherever possible.

3.10 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the

high point in the system.

D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

F. Entire test must be witnessed by the local authority having jurisdiction. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Clear Water Waste &Vent	Water	N/A	10’ Water 2 Hour
Storm & Clear Water Waste	Water	N/A	10’ Water 2 Hour

END OF SECTION

SECTION 220160 - NATURAL GAS SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the complete natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.2 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

D. 2018 Edition of the International Fuel Gas Code.

E. Latest Edition of NFPA 54, National Fuel Gas Code.

1.3 QUALITY ASSURANCE

A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

B. Valves: Manufacturer’s name, size, standards compliance and pressure rating clearly marked on outside of valve body.

C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.4 SUBMITTALS

A. Product Data:

B. Provide code and standards compliance verification, manufacturer's product data and ratings on pipe materials, pipe fittings, regulators, valves and accessories.

1.5 DELIVERY, STORAGE and HANDLING

A. Accept valves on Site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

1.6 EXTRA MATERIALS

A. Provide one (1) plug valve wrench for every ten (10) plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench incorporating a setscrew.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Natural gas pressures shall not exceed five (5) pounds per square inch gauge on Owner's side of the meter.

C. Pipe joint compound shall be lead-free, non-toxic, non-hardening, insoluble in the presence of natural gas and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15 degrees F to +400 degrees F, manufactured by Hercules "MegaLoc" or approved equal by Rectorseal, La-Co or Oatey.

2.2 PIPING

A. Buried Piping Outside of Building:

1. Polyethylene, SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.

2. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.

3. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

B. Above Ground Piping Outside of Building (Including roof):

1. Piping 2 inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

2. Piping 2½ inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

3. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

C. Above Ground Piping Inside of Building:

1. Piping 2 inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

2. Piping 2½ inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

D. Above Ground Piping Concealed Inside of Building ("Concealed Piping" as defined by the International Fuel Gas Code, 2018):

1. Piping 2 inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2. Piping 2½ inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

3. Piping above ceilings 2 inches and smaller may be installed as threaded in lieu of welded provided that all piping is encased within steel sleeve vented to the exterior of the building. Sleeve piping shall be Schedule 10 black steel pipe conforming to ASTM A53, Grade A or B, electric resistance welded or seamless, with roll-grooved ends. Sleeve pipe couplings shall be Victaulic Style 75 with Grade T nitrile gasket. Sleeve fittings shall be Victaulic grooved malleable or steel. Sleeve piping and fittings must be two pipe sizes, but not less than 1 inch larger than encased gas piping.

2.3 UNDERGROUND WARNING TAPE

A. Minimum 3-inch-wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.

B. Lamination bond of one (1) layer of Minimum 0.35 mils thick aluminum foil between two (2) layers of minimum 4.3 mils thick inert plastic film.

C. Minimum tensile strength: 63 LBS per 3 IN width.

D. Minimum elongation: 500 percent.

E. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe buried below (e.g.: "CAUTION GAS LINE BURIED BELOW").

F. Manufactured by Reef Industries “Terra Tape” or approved equal.

2.4 VALVES

A. All valves shall be designed, manufactured and approved for natural gas service.

B. Line Shut-off Valves sizes 2 inches and smaller shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and –20 to 200 degrees F., manufactured by Resun Model R-1430, Nordstrom Model 142, or approved equal.

C. Line Shut-off Valves sizes 2½ inches and larger shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and –20 to 200 degrees F., manufactured by Resun Model R-143, Nordstrom Model 143, or approved equal.

D. Appliance/Equipment Shut-off Valves at local connections sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F., manufactured by Nibco Model T585-70-UL, Model T580-70-UL, Milwaukee Model BB2-100, or approved equal.

E. Manual Emergency Shut-off Valves sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F., manufactured by Nibco Model T585-70-UL, Model T580-70-UL, Milwaukee Model BB2-100, or approved equal.

F. Automatic Emergency Shut-off Valves shall be U.L. Listed F.M. Approved for natural gas service, 2-way electrically tripped solenoid type; fail safe closed; manual reset; Type 1 solenoid enclosure; NBR seals and disc; stainless steel core tube and springs; copper coil; manufactured by ASCO Red Hat Series 8044, or approved equal.

2.5 PRESSURE REGULATORS

A. All pressure regulators shall be designed, manufactured and approved for natural gas service.

B. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm. Manufactured by Rockwell or Fisher.

C. Install pressure gauge adjacent to and downstream of each line pressure regulator.

2.6 UNIONS

A. Unions in 2 inches and smaller in ferrous lines shall be right- and left-hand nipple/coupling assembly, or ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends, 2-1/2 inches and larger shall be ground flange unions. Companion flanges on lines at various items of equipment, machines and pieces of apparatus may serve as unions to permit disconnection of piping.

B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.

C. Above grade flexible stainless-steel appliance/equipment connectors shall conform with AGA under the ANSI Z21.69 Standard. Hose shall be braided stainless steel with a polyolefin heat-shrink tubing with high flame-retardant qualities. Hose shall be equipped with malleable iron unions and spring-loaded brass quick-link couplings. An easily accessible manual shut-off valve shall be installed ahead of all hose connections. Specify T&S Brass "Safe-T-Link" or approved equal.

2.7 FLANGES

A. All 150 lb. and 300 lb. ANSI flanges shall be domestically manufactured, weld neck forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Flanges shall have the manufacturer’s trademark permanently identified in accordance with MSS SP-25. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat-faced flanges shall be required to match flanges on check valves, strainers, and other valves and devices. Only one manufacturer of weld flanges will be approved.

B. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16 inch thick, non-metallic, non-asbestos gasket material suitable for operating temperatures from -150 degrees F to +75 degrees F, Klingersil C-4400, Manville Style 60 service sheet packing, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe ends and remove cutting burrs. Bevel plain end ferrous pipe.

B. Remove cutting oil, scale and dirt, on inside and outside of piping, before assembly.

3.2 EQUIPMENT CONNECTIONS

A. Provide specified connections, shutoff valves, regulators and unions at each and every appliance and piece of equipment requiring natural gas.

B. Provide and install union type connections at all equipment to permit removal of service piping.

C. Gas service connections shall have a diameter at least one pipe size larger than that of the inlet connection to the equipment as provided by the manufacturer and be of adequate size to provide the total input demand of the connected equipment.

D. Provide listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment. Connectors shall have listed and labeled quick-disconnect devices and shall have retaining cables attached to structures and equipment. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

E. Rigid metallic pipe and fittings shall be used at service connections to all stationary equipment.

3.3 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Provide support for and connections to natural gas service meter in accordance with requirements of the utility company, when so indicated on the Drawings.

D. All installation shall be in accordance with manufacturer’s published recommendations.

E. Distribution piping shall be as short and as direct as practicable between the point of delivery and the outlets.

F. Do not install underground piping when bedding is wet or frozen.

G. Bury all underground piping at least 3 feet below finished grade. Provide a continuous detectable warning tape on tamped backfill, 12 inches above all buried non-metallic gas lines.

H. Do not install gas piping in the same trench with other utilities. The minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Do not install gas pipe through catch basins, vaults, manholes or similar underground structures.

I. Install and support all polyethylene piping in accordance with manufacturer's recommendations. All heat fusion welds shall be performed by welders qualified to the manufacturer’s procedures.

J. Polyethylene piping shall not be installed above ground.

K. Provide connection between buried plastic gas piping and metallic riser in accordance with the gas code.

L. All above ground gas piping shall be electrically continuous and bonded to electrical system ground conductor in accordance with NFPA 70.

M. Provide and install union type fittings at proper points to permit dismantling or removal of pipe. No unions will be required in welded lines except at equipment connections. Where union type fittings are necessary for piping dismantling purposes, right and left nipples and couplings shall be used. Flanges, ground-joint unions or approved flexible appliance connectors may be used at exposed fixture, appliance or equipment connections.

N. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.

O. Valves, regulators, flanges, union type fittings and similar appurtenances shall be accessible for operation and servicing and shall not be located above ceilings, within chases, walls/partitions, spaces utilized as return air plenums or non-accessible locations.

P. Route piping in orderly manner and maintain gradient. Install piping to conserve building space. Group piping whenever practical at common elevations.

Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

R. Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main no lower than the horizontal midpoint of the gas main.

S. Close nipples, bushing and cross type fittings shall not be installed in any gas piping system.

T. Slope piping and arrange to drain at low points. Install drip/sediment traps at points where condensate and debris may collect. Locate drip/sediment traps where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drip/sediment traps using tee fitting with capped nipple connected to bottom outlet. Use minimum-length nipple of 3 pipe diameters, but not less than 4 inches long, and same size as connected pipe. Cap shall be screwed pattern, black, standard weight, malleable iron. Install with adequate space for removal of cap.

U. Install valves for shut off and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible. All flanged valves shown in horizontal lines with the valve stem shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance.

V. Install line shut-off valve at each branch connection to riser.

W. Provide adequate clearance for access to and operation of all valves.

X. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.

Y. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminated with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least seven feet above grade or pedestrian traffic and a minimum three (3) feet above or twenty-five (25) feet horizontally from all air intakes or building openings.

Z. Above ground horizontal natural gas and encasement piping shall be supported at intervals of no greater than 6 feet for 1/2-inch piping, 8 feet for 3/4 inch and 1 inch piping and 10 feet for 1-1/4 inches and larger piping. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.

AA. Extension bars shall not be used for supporting gas or encasement piping. Gas or encasement piping shall not be used to support any other piping or component.

BB. Provide piping and valve identification in accordance with Project Specification Section 20 05 53.

3.4 INSTALLATION OF WELDED PIPING

A. Welding of pipe in normally occupied buildings is prohibited. Off-Site welding is acceptable. Should welding be required in a normally occupied building for connecting to an existing welded system, obtain written approval from the Owner and comply with Owner's fire and life safety requirements.

B. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI the latest editions of Standard B32.1 for all systems from the Code for Pressure Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

C. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37-½ inch degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.

D. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

E. Contractor shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welded during welding operation.

F. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

G. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.

H. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

3.5 TESTING

A. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required herein.

B. All necessary apparatus for conducting tests shall be furnished by the Contractor and comply with the requirements of NFPA 54.

C. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed herein. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.

D. Systems on which the normal operating pressure is less than 0.5 pounds per square inch gauge (psig), the test pressure shall be 5.0 psig and the time interval shall be 30 minutes.

E. Systems on which the normal operating pressure is between 0.5 psig and 5.0 psig, the test pressure shall be 1.5 times the normal operating pressure or 5.0 psig, whichever is greater, and the time interval shall be 30 minutes.

F. Systems on which the normal operating pressure is 5.0 psig or greater, the test pressure shall be 1.5 times the normal operating pressure, and the time interval shall be one (1) hour.

G. After testing is complete, the entire gas system shall be purged with dry nitrogen to eliminate all air, debris and moisture from the piping before natural gas is introduced into the system.

H. After successful results of pressure test and purging have been completed, a leakage test shall be performed in accordance with NFPA 54 Appendix D.

I. Connect, inspect and purge gas utilization equipment, lab hook-ups and outlets, and place into operation only after successful results of pressure test, leakage test and purging have been completed and accepted.

J. Testing operations shall be repeated until gas-piping systems are absolutely tight at the pneumatic test pressures indicated above.

K. Pressure test gas piping sleeve system with clean, dry compressed air at 15 psig by temporarily sealing all openings between gas carrier pipe and sleeve and vent openings. Sleeve systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of four hours.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. The intent of these specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes.

1.2 CODES

A. All material and equipment provided and installed as part of these construction documents shall be in compliance with the latest edition of the adopted codes and applicable standards by the State in which the work is performed.

1.3 RESPONSIBILITY

A. The Construction Manager/General Contractor (CM/GC) shall be responsible for all work included in Division 22. The delegation of work to the contractors shall not relieve him of this responsibility. Contractors who perform work under this Division shall be responsible to the CM/GC.

1.4 PERMITS

A. Obtain and pay for permits, fees, certificates of inspection and approval, etc. required for this work. Furnish Owner with certificates of final inspection and approval prior to final acceptance of the work.

B. Laws and regulations which bear upon or affect the work shall be complied with.

1.5 SITE VISIT

A. Prior to preparing the bid, the mechanical plumbing subcontractor shall visit the site and become familiar with all existing conditions. Make all necessary investigations as to locations of utilities and all other matters which can affect the work. No additional compensation will be made to the contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.6 OUTAGES

A. For all work requiring an outage, the plumbing contractor shall submit an outage request to the Architect / Owner.

B. The existing plumbing system shall remain operational unless coordinated with the Architect / Owner during the construction of the project.

C. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten business days (10) days in advance. Outages shall be performed so as to minimize disruption to the owner. If necessary, some outage work may be performed outside normal hours if approved by Owner.

D. All plumbing outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon by the contractor and the Owner.

E. The plumbing contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and at the convenience of the Owner.

1.7 REQUESTS FOR INFORMATION

A. Submit all questions, requests for information (RFIs) and similar queries through the formally established RFI process for the project that has been accepted by the Owner's Representative, Design Professionals, CM/GC, and subcontractors.

1.8 SUBMITTALS

A. Provide submittals for all material, equipment and supports as specified in Division 22 and where indicated on the drawings and details. At a minimum the following submittals shall be provided as required by the project unless otherwise noted:

1. Pipe, fittings and accessories
2. Valves, strainers and unions
3. Insulation
4. Hangers and supports
5. Plumbing fixtures and trim
6. Safety fixtures and equipment
7. Backflow preventers
8. Identification labels and tags
9. Floor drains
10. Roof drains
11. Hot water heating equipment
12. Trap priming system
13. Plumbing pumps
14. RO/DI equipment and pipe
15. Laboratory compressed air system
16. Laboratory vacuum system
17. Laboratory gas outlets

B. Warranties and maintenance instructions shall be included in the O & M Manual only. Do not include this data in the Product Submittals.

C. The Contractor shall provide to the Architect for review electronic copies of required submittals, in PDF format, unless noted otherwise. All Catalog Data, Shop Drawings, Calculations, and Certificates of Compliance shall be submitted as a single package. Failure of the contractor to provide a complete submittal package may result in delay in processing time. All such delays to the job resulting from the contractor's failure to provide submittals at one time will be the responsibility of the Contractor. Submittals shall clearly identify the contract documents specification section or drawing referenced, identifying and highlighting each item to be reviewed.

D. Submittals provided for review shall clearly and completely describe the specific product(s) they represent. Where differences exist between the item specified and that submitted for review, the submittal shall be highlighted.

E. Submittals shall bear the review stamp of the Contractor. The review stamp of the Contractor shall be affixed to shop drawings to indicate:

1. The Contractor has coordinated the electrical characteristics of the equipment.

2. The Contractor has verified that the equipment submitted will physically fit into the space allocated with adequate clearances for maintenance, access, and egress requirements.

3. The Contractor shall bear all associated costs that may accrue due to failure to completely represent a given product.

F. Material and equipment shown on the drawings or specified herein shall not be incorporated in the work of this Contract until shop drawings, engineering data, and catalog information have been reviewed and accepted by the Engineer.

G. The installing contractor shall maintain as-built drawings; and, shall provide the complete set at the time of final close out. As-built drawings are to be provided, in PDF format on compact disk or DVD.

1.9 VARIANCES

A. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Engineer shall decide on the item and manner in which the work shall be provided.

1.10 PERFORMANCE REQUIREMENTS

A. Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required. Furnish and install all items as may be required to fit the work to the conditions encountered. Install all new work in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Do not scale from drawings, all measurements should be taken in the field.

B. Arrange plumbing piping, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.

C. Coordinate all work with all other contractors and installers in addition to existing building obstructions and install accordingly. Comply with requirements of architectural drawings including but not limited to mounting height and locations. Fully research peculiarities and limitations of space available for installation of work with materials being provided. Work around material lead times to not extend project schedule.

1.11 QUALITY ASSURANCE

A. Contractor shall have a minimum five (5) years' experience in the installation of systems similar to the systems specified. Contractor, if requested, shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

1.12 WARRANTY / GUARANTEE

A. Provide a warranty/guarantee in written form as part of O&M manual stating that all work, materials, equipment and parts are warranted to be free of defect for a minimum period of one year from the date of Substantial Completion. Warranty period and requirements may be expanded in drawings or subsequent specification sections. Repair or replace (owner's option) any defects or failures at no cost to the owner within the warranty period. Issues arising within warranty period must be attended to in a timely manner and in no case exceed four (4) working days. State this in writing as part of O&M manual. Replace defective items to the satisfaction of the Owner's Representative and the Design Professional.

PART 2 PRODUCTS

2.1 GENERAL

A. The listed manufacturers represent the basis for design and identify the minimum level of quality for materials and equipment, specified in this Division, that are acceptable. Contractors may submit material and equipment by non-listed manufacturers provided submittals meet the requirements of these specifications. All submitted materials and equipment are subject to approval by the Engineer.

B. Provide materials that are new, full weight, and of the best quality. Obtain equipment, components and materials from single manufacturer for products of the same kind or category. Provide materials that are listed and labeled and marked for intended location and application.

C. The equipment layouts and the related mechanical and electrical service connections, access space and supports indicated on the construction documents represent equipment provided by the specified basis of design manufacturer and model number. When the successful bidder chooses to provide equipment by another approved manufacturer, the bidder shall be responsible for providing all adjustments and modifications to the services necessary to make connections to the

equipment, the bidder shall be responsible for installing the equipment such that all required clear access space is maintained, and the bidder shall be responsible for providing all adjustments and modifications to the equipment mounting and supports. All adjustments and modifications shall be provided by the bidder and appropriate subcontractors at no additional cost to the project.

PART 3 EXECUTION

3.1 GENERAL

A. Unless specifically indicated, provide all specified and drawn work as required to render all equipment and systems fully operational, including all ancillary, accessory, and support work. Install equipment and materials in strict accordance with manufacturer's written instructions.

B. In cases where products or materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.

C. Examine surfaces to receive products for suitable mounting conditions and verify compliance with installation tolerances and other conditions affecting performance of the work. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Equipment shall be installed in accordance with manufacturer’s installation recommendations. Provide and maintain service, maintenance and operating clearances as required by the manufacturer.

E. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.

3.2 COORDINATION ITEMS

A. Coordinate sizes and locations of concrete housekeeping pads with architectural and structural elements. Concrete housekeeping pads shall be provided with all equipment provided. Concrete shall be 3,500 psi twenty-eight (28) day compressive strength concrete with reinforcement bars as specified in the architectural specifications.

B. Cut and drill all openings in roofs, walls, and floors required for the installation. Neatly patch all openings cut. Hold cutting and patching to a minimum by arranging with other contractors for all sleeves and openings before construction is started. When drilling/cutting concrete slabs, utilize ground penetrating radar (GPR) and/or X-ray scanning equipment to verify the location is free from obstructions, including but not limited to: structural rebar/strands/tendons, electrical conduit/wiring, and/or piping/ductwork.

3.3 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Receive, inspect, store and protect all materials required for new work. Do not accept or install any product damaged in any way.

B. Comply with all manufacturer guidelines and requirements for movement, storage, and protection of new work. All new work must be stored in a clean, dry place protected from weather and construction traffic. Maintain acceptable temperature and humidity per manufacturer recommendations.

C. Prior to installation, all products shall have the ability to be returned to the supplier or manufacturer after purchase and charged a reasonable restocking fee equal to a small portion of the cost.

D. Protect all new work through construction from damage. Take safeguards necessary to protect from damage. Items damaged during construction will not be accepted and shall be replaced with new.

E. Remove and replace all materials that have been installed improperly, physically damaged, moisture or water damaged, or mold damaged.

F. Protect drains throughout all phases of construction to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

G. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.4 EXCAVATING AND BACKFILLING

A. Perform all excavation and backfilling required for admittance of work. Execute work safely providing slope sides, shoring and bracing as required for stability.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations. Properly restore streets, sidewalks, concrete and blacktop surfaces that were broken during the excavation process.

C. Underground drainage piping shall be laid on a 6” of well-tamped bedding course of a sand/gravel mix with a maximum 3/8” particle size. Bedding shall be scooped out at the bells or couplings to ensure the piping is well supported throughout its entire length. Sand/gravel mix should be firmly compacted under, around, and above the pipe in 6” lifts to grade. Compaction should be a minimum of 95 percent of standard proctor according to ASTM D698.

D. Underground piping installations shall conform with ASTM D2321/F1668 and CISPI 301.

E. Install piping materials in accordance with the manufacturer’s requirements and in conjunction with the standards referenced in this specification. Installation methods shall comply with the more restrictive standards.

3.5 STARTUP, TESTING, AND ADJUSTMENTS

A. Adjust fixtures, equipment, accessories, and moving parts to function smoothly and lubricate as recommended by manufacturer.

B. Provide necessary power to fixtures, equipment, and accessories to ensure proper functionality.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.6 CLEANING EQUIPMENT AND PREMISES

A. Vacuum, clean and wipe down all new work and equipment inside and out. Exposed parts which are to be painted shall be cleaned of all foreign objects and prepped for paint.

B. During the progress of work, clean up and leave the premises and portions of the building in which work has occurred in a clean and safe condition. Provide this cleaning on a per-shift basis.

3.7 DEMONSTRATION / TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION

SECTION 22 05 14 - PLUMBING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. This specification provides requirements for miscellaneous plumbing specialties.

1.02 REFERENCE STANDARDS

A. ANSI A112.14.1 – Backwater Valves

B. ANSI A112.21.1 – Floor Drains

C. ANSI A112.21.2 – Roof Drains

D. ANSI A112.26.1/PDH WH-201 – Water Hammer Arrestors

E. ASSE 1010 – Water Hammer Arrestors

F. ASSE 1013 – Reduced Pressure Principle Backflow Preventers

G. ASSE 1018 – Trap Seal Primer Valves

H. ASSE 1019 – Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Type

PART 2 PRODUCTS

2.01 FLOOR DRAINS

A. Subject to compliance with requirements, provide floor drains by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

B. Floor drains will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.02 TRAP GUARDS

A. Subject to compliance with requirements, provide trap guards by one of the following:

1. ProVent Systems

2. JR Smith

3. Mifab

4. SureSeal

B. Flexible elastomeric PVC construction diaphragm trap guard. Size per drain outlet size, up to 4” size. Larger than 4” size require trap primer. Plumbing schedule sheet will indicate whether drain requires trap guard or trap primer.

2.03 FLOOR SINKS

A. Subject to compliance with requirements, provide floor sinks by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

B. Floor sinks will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.04 HUB DRAINS

A. Subject to compliance with requirements, provide hub drains by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

B. Hub drains will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.05 ROOF DRAINS

A. Subject to compliance with requirements, provide roof drains by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

B. Roof drains will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.06 TRENCH DRAINS

A. Subject to compliance with requirements, provide trench drains by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

6. Dura Trench

7. Mifab

B. Trench drains will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.07 CLEANOUTS

A. Subject to compliance with requirements, provide cleanouts by one of the following:

1. Josam

2. JR Smith

3. Wade

4. Watts

5. Zurn

B. Cleanouts will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.08 BACKWATER VALVES

A. Subject to compliance with requirements, provide backwater valve by one of the following:

1. Josam

2. JR Smith

3. Watts

4. Zurn

B. Backwater Valve will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.09 WATER HAMMER ARRESTORS

A. Subject to compliance with requirements, provide water hammer arrestor by one of the following:

1. PPP Industries

2. JR Smith

3. Watts

4. Zurn

5. Sioux Chief

B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant, suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig surge pressure.

2.10 BACKFLOW PREVENTERS - RPZ

A. Subject to compliance with requirements, provide Reduced Pressure Zone backflow preventer (RPZ) by one of the following:

1. Wilkens

2. Watts

3. Zurn

4. Febco

B. RPZ will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet. Provide complete with inlet strainer, inlet and outlet ball or non-rising stem gate isolation valves. Lead free. Constructed of bronze cast iron body with bronze and plastic internal parts, stainless steel springs, non-threaded vent outlet, 4 test cocks, rated for 175 psig and 180 degrees F, with air gap apparatus on drain. Shall include flood detection sensor on relief valve.

2.11 WALL HYDRANTS

A. Subject to compliance with requirements, provide wall hydrants by one of the following:

1. Josam
2. JR Smith
3. Wade
4. Watts
5. Zurn
6. Woodford

B. Wall hydrants will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.12 YARD/ROOF HYDRANTS

A. Subject to compliance with requirements, provide yard/roof hydrants by one of the following:

1. JR Smith
2. Watts
3. Zurn
4. Woodford

B. Yard/Roof hydrants will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.13 HOSE BIBBS

A. Subject to compliance with requirements, provide hose bibbs by one of the following:

1. Chicago Faucets
2. JR Smith
3. T&S Brass
4. Watts
5. Zurn
6. Woodford

B. Hose bibbs will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.14 ICE MACHINE WALL BOXES

A. Subject to compliance with requirements, provide ice machine wall boxes by one of the following:

1. Guy Gray

2. Oatey

B. Ice machine wall boxes will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

2.15 WASHING MACHINE WALL BOXES

A. Subject to compliance with requirements, provide washing machine wall boxes by one of the following:

1. Guy Gray

2. Oatey

B. Washing machine wall boxes will use manufacturer and model number on plumbing schedule as basis of design. See plumbing schedule sheet.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturer's instructions.

3.02 INSTALLATION

A. Set floor drains, roof drains, trench drains, and cleanouts level and plumb adjusted to finished floor elevation. Locate where serviceable. Allow minimum of 18” clearance around cleanouts for rodding. Provide deep seal traps on all floor drains and trench drains. Install trap primer connections or trap guards as indicated on drawings.

B. Set backwater valves on undisturbed soil or compacted granular backfill, level and plumb with top adjusted to finished floor elevations. Test and adjust valve for proper operation. Allow minimum 18” clearance for servicing.

C. Install water hammer arrestors where indicated on drawings and at all quick closing valve installations.

D. Install backflow preventers RPZ in accordance with state, local, and AHJ requirements. Maintain minimum clearance distances for servicing and testing.

E. Provide indirect waste piping with air gap installation from relief opening to where indicated on drawings.

F. Mount wall hydrants recessed in exterior wall 24” minimum above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.

G. Mount yard hydrants with discharge 27” minimum above finished grade. Set base of hydrant in 1 cu. yd. of granular backfill material for free drainage. Crown finished grade materials for drainage away from hydrant.

H. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb.

I. Install ice and washing machine boxes in wall construction, secured to structure, as shown on drawings. Provide water hammer arrestors in supply piping. Mount boxes a minimum of 36” above finished floor.

END OF SECTION

SECTION 220548
VIBRATION ISOLATION AND SEISMIC RESTRAINT FOR PLUMBING COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.
Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

1.2 DESCRIPTION

This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II, III, & IV structures, including, but not limited to:

Plumbing Components: Gas piping; water piping; waste or vent piping; water heaters, etc.

Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

1.3 DEFINITIONS

Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.
Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.
Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.
Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.
Component Importance Factor (I_p): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.
Consequential Damage: Failure of an essential component caused by the failure of a separate essential or non-essential component due to the functional and physical interrelationship of the components, their supports, and their effect on each other.
Designated Seismic System: Those nonstructural components that require design in accordance with Chapter 13 of ASCE 7, for which the Component Importance Factor (Ip) is 1.5 in accordance with Section 13.1.3 of ASCE 7.
Special Seismic Certification: A certificate of compliance, supplied by the manufacturer of Active Designated Seismic Systems, which certifies that the equipment will remain operable during the design seismic event. Components with hazardous contents shall be certified as maintaining containment following the design seismic event.
Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.

Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

1.4 REGULATORY REQUIREMENTS

Comply with the 2015 International Building Code (IBC) and applicable local adopted amendments, and the 2010 Edition on ASCE 7 (ASCE 7-10).

1.5 DESIGN PERFORMANCE CRITERIA

Provide seismic restraint of components to withstand seismic forces and displacements without displacing or overturning. Design of seismic restraint shall be performed in accordance with the 2015 International Building Code and ASCE 7-10, as follows.

Seismic forces shall be determined in accordance with Chapter 13 of ASCE 7-10. The seismic design parameters shall be as noted in the project Structural drawing. The assigned Component Importance Factors (Ip) for each component, shall be as noted on the project drawings and/or specifications.

For components installed on the exterior of the building, wind forces shall be determined in accordance with Chapter 29 of ASCE 7-10, except that the uplift forces per Equation 29.5-3 shall be considered regardless of the building height. Reference the Structural drawings for wind design criteria.

In addition to seismic and wind loads, consideration shall be given to other loads, including but not limited to dead, live, snow, etc., as applicable. All restraint design shall be based on the "worst case" combination of the applicable loads as prescribed by the referenced code and standards.

Consideration shall also be given to thermal stresses and expansion. Where thermal expansion applies, seismic restraint design shall be in accordance with the requirements of ASME B31.1 in addition to ASCE 7.

1.6 SUBMITTALS

Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.
Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation and seismic restraint.
Vibration Isolation: submit the following, at a minimum, as applicable.

Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.

Detailed drawings showing equipment, isolator bases and isolator spacing.

Descriptive data or cut sheets for each type of isolation mounting, including:

a. Dimensional data

b. Materials and finish

c. Rated loads

d. Rated deflection

e. Isolator free and operating heights

f. Detailed installations instructions

Seismic Restraint: submit the following, at a minimum, as applicable.

Catalog cut or data sheets on specific restraints detailing compliance with the project drawings and specifications.

Detailed schedules of components, showing seismic restraints by referencing numbered descriptive drawings.

Description, layout and location of items to be restrained with anchorage or brace points noted and dimensioned.

Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, fasteners, bolts, welds etc. clearly identified and specified.

Numerical value of design seismic restraint loads, or controlling loads if different than load combinations with seismic, with all supporting calculations.

Detailed installation instructions for seismic restraints.

Acceptable attachment methods of seismic restraints to structural members.

Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.

Details for housekeeping pads for base-mounted equipment, including reinforcing and doweling requirements to the building structure.

Documentation verifying seismic prequalification for anchors in concrete per ACI 318 Appendix D.

Additional information as required to substantiate adequate design and installation of seismic restraints.

Manufacturer's Seismic Certificate of Compliance: Each manufacturer of a Designated Seismic System (with a Component Importance Factor, Ip = 1.5) shall submit a ***Certificate of Compliance*** for review and acceptance by the design professional in responsible charge and the authority having jurisdiction, prior to installation.

PART 2 - PRODUCTS

2.1 GENERAL

All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
Refer to the "Selection Guide" table in Section 4 to correlate the specification references listed below with the appropriate components.

2.2 MANUFACTURERS

Isolators and seismic restraints shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators and seismic restraint systems listed in the following sections are as manufactured by Gripple and California Dynamics.

Gripple

California Dynamics

The VMC Group

Mason Industries

Kinetics Noise Control

Cooper B-Line

CADDY

Hilti

Twin City Hose

Imperial Metals

2.3 EQUIPMENT BASES

Specification B-1 (Integral Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-2 (Wide Flange Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-3 (Concrete Inertia Base): Rectangular steel concrete pouring forms for floating concrete frames. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 12" centers running both ways in a layer 1 1/2" above the bottom. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Base shall be type CW as manufactured by California Dynamics Corporation or approved equal

Specification B-4 (Non-Isolated Curbs): Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchored to concrete deck, or bolted or welded directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. **Curb shall use minimum 18 gage galvanized steel and shall be designed with cross bracing required to withstand the greater of calculated seismic forces and /or wind loading per local building code**. Design must be certified by registered professional engineer.

Specification B-5 (Isolated Curbs): Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. The upper curb shall be supported by Spec SV-1 isolators welded or bolted to concrete deck to the structure to withstand seismic loading. An EPDM nylon reinforced air tight weatherproof seal shall consolidate the upper and lower curbs. The lower curb shall be weatherproof and provide a base that the roofing system may be flashed to. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings**. Isolation curb shall be designed to withstand the greater of calculated seismic forces and / or wind loading per local building code**. Design must be certified by registered professional engineer.

Specification B-6 (Non-Isolated Rails): Non isolated seismically rated rooftop rail system that provides equipment support in one roof flashed assembly with all features as described for Non-Isolated Curbs.

Specification B-7 (Isolated Rails): Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment. Structural steel rails shall be type, WW as manufactured by California Dynamics Corporation or approved equal.

2.4 VIBRATION ISOLATION

Specification V-1 (Pad Type Elastomer Isolator): A pad type mounting consisting of two layers of ribbed elastomeric pads with a 1" sandwich pad in between. Where the equipment foot is less than 80 percent of the surface of the pad a load distribution plate must be added to the top of the pad. Pads shall be VT as manufactured by California Dynamics Corporation or approved equal.

Specification V-2 (Neoprene Mounting): Elastomeric mounts single or double-deflection type, oil-resistant rubber or Neoprene isolator element with factory-drilled, bonded in place top plate for bolting to equipment and factory drilled base plate for bolting to structure. Color-coded or otherwise identify to indicate capacity range. Mount shall be type RM/RMD as manufactured by California Dynamics Corporation or approved equal.

Specification V-3 (Spring Isolator, Free Standing): Spring isolators shall be free standing and laterally stable without any housing and complete with a Neoprene acoustical pad between the base plate and the spring support. All mountings shall have load transfer bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mountings shall be type SSL/K, as manufactured by California Dynamics Corporation or approved equal.

Specification V-4 (Elastomer Hanger Isolator): Hanger shall consist of a rigid steel frame and up to ½"deflection of a molded Neoprene element projecting thru the steel box so that no metal-to-metal contact occurs. Hanger shall be type RH/RHD as manufactured by California Dynamics Corporation or approved equal.

Specification V-5 (Spring Hanger Isolator): Hanger shall consist of a rigid steel frame containing a steel spring with a Neoprene sleeve to prevent steel to steel contact. Hanger shall be type CH as manufactured by California Dynamics Corporation or approved equal

Specification V-6 (Combination Spring/Elastomer Hanger Isolator): Hangers shall consist of rigid steel frames containing double deflection Neoprene element at the top and a steel spring and a Neoprene sleeve on bottom to position spring and prevent steel to steel contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc from side to side. Hangers shall be type HH30 as manufactured by California Dynamics Corporation or approved equal.

2.5 VIBRATION ISOLATION WITH SEISMIC RESTRAINT

Specification SV-1 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A steel housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. The housing shall be Zinc plated. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be CQA as manufactured by California Dynamics Corporation or approved equal. This product is an OSHPD/ DSA approved product. Product tested for IBS.

Specification SV-2 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A welded housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be DLK as manufactured by California Dynamics Corporation or approved equal.

Specification SV-3 (Neoprene Mounting with Seismic Snubber) JQTQN Restrained Neoprene isolators shall be free standing, with a rated static defection of .5". A steel housing with cushioned lateral and vertical limit stops to restrict extension due to wind loads, or when weight is removed. The housing shall be hot-dipped galvanized or zinc plated. Hot-Dipped zinc coating shall be not less than 2 ounces per square foot complying with ASTM A123. A clearance of ¼ "maximum shall be maintained around restraining bolts and between the housing and the Neoprene so as not to interfere with the isolator action. Limit stops shall be out of contact during normal operation. Isolator/Restraint shall be JQTQN as manufactured by California Dynamics Corporation.

2.6 SEISMIC RESTRAINTS

Specification S-1 (Seismic Snubbers): All directional seismic restraints shall consist of interlocking steel members. Neoprene shall have a minimum thickness of ¼". Incorporate a minimum air gap of 1/8", and a maximum air gap of ¼" in the design, before contact is made between the rigid and resilient surfaces. Provide removable end plate to allow inspection of internal clearances. Restraints shall be type RL-A/ RL-C as manufactured by California Dynamics Corporation.

Specification S-2 (Seismic Cable Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable Restraints shall be listed with any one of following evaluation agencies with certified break strength and shall be color-coded or include a tag for easy field verification.

1. IAPMO-UES
2. ICC-ES
3. OSHPD
4. Underwriters Laboratories (UL)

Secure cable to structure and braced component through bracket or stake eye specifically designed to meet or exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASTM A1023 or EN-12385 or other approved equivalent. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Gripple Inc. GS series.

Specification S-3 (Rigid Brace Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of steel angles or channels. Rigid braces and connecting elements shall be sized for the applied seismic loads. Connecting elements shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment. Restraint shall be CADDY Strut Seismic Hinge.

2.7 FLEXIBLE PIPE CONNECTIONS

Specification F-1 (Water Service Flexible Connection):

For flanged connections – A double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35 degree angular movement up to 6”, minimum 30 degree up to 12” and minimum 20 degree up to 24”. Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Twin City Hose Type MS2.

For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, ¼” extension and 20 degree angular through 1-1/4”, 13 degree through 2”, and 9 degree through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to ¼”. Flex connector shall be Twin City Hose Type MSFU.

Specification F-2 (Steam and Condensate Service):

For flanged connection – A metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Twin City Hose Type TCHS-FLG.

For threaded connections – A metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Twin City Hose Type TCHS-MMT.

PART 3 - EXECUTION

3.1 EXAMINATION

All areas that will receive components requiring vibration isolation and seismic restraint shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

3.2 INSTALLATION, GENERAL

Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.
Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

3.3 SEISMIC RELATIVE DISPLACEMENTS

Provide joints with sufficient flexibility capable of accommodating seismic relative displacements as follows.

Vertical ductwork, piping, etc. that pass between floors of the building,

Components that pass through a building seismic or expansion joint,

Rigidly supported components that connect to other components.

3.4 POST-INSTALLED ANCHORS:

Install all anchors in accordance with the manufacturer's written instructions for seismic applications.
Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

3.5 HOUSEKEEPING PADS

Housekeeping pads shall be designed by the seismic restraint vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated seismic or wind forces. Frictional resistance due to the effects of gravity shall be neglected.
The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.

If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

3.6 PLUMBING COMPONENTS

Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.

Design equipment anchorage to resist seismic design force in any direction.

Design vibration and seismic controls for equipment to include base and isolator requirements.

Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.

Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.

Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.

Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.

Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.

Suspended plumbing equipment

Design support and bracing to resist seismic design force in any direction.

Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.

Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.

Wall-mounted plumbing equipment

Design attachments to resist seismic design force in any direction.

Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

Piping

Provide supports, braces and anchors to resist gravity and seismic design forces.

Design piping and piping risers to accommodate interstory drift. Provide flexible connections wherever relative differential movements could damage pipe in an earthquake.

Brace every run (5' or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center.

Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.

Where piping is explicitly exempt from seismic bracing requirements,

a. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components. This will be considered satisfied if there is horizontal clear distance of at least 2/3 the hanger length between subject components.

b. Provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.

3.7 QUALITY CONTROL

A. Do not install vibration isolators or seismic restraints until submittals have been reviewed and approved by the registered design professional in responsible charge.
B. Verify that multiple systems installed in the same vicinity can be installed without conflict.
C. Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.
D. Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.
E. No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.
F. Where Special Inspections are required per Sections 1704 and 1705 of the 2015 International Building Code, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE

PLUMBING EQUIPMENT

EQUIPMENT TAG	Ip (Note 4)	ISOLATION SPEC.	ISOLATION DEFL.	SEISMIC REST. SPEC. (NOTE 1)

GAS PIPING	1.5	NONE	N/A	SPEC S-2
GAS WATER HEATERS	1.5	NONE	N/A	NOTE 2
STEAM WATER HEATERS	1.5	NONE	N/A	NOTE 2
ELECTRIC WATER HEATERS	1.0	NONE	N/A	NOTE 2
VACUUM PUMPS	1.0	N/A	N/A	NOTE 2
DOMESTIC WATER	1.0	NOTE 3	N/A	SPEC S-2
WASTE, VENT PIPING	1.0	NONE	N/A	SPEC S-2
STORM DRAIN PIPING	1.0	NONE	N/A	SPEC S-2
COMPRESSED AIR PIPING	1.5	NOTE 3	N/A	SPEC S-2
AIR COMPRESSORS	1.5	N/A	N/A	NOTE 2

NOTES

1. Provide seismic restraint per table or as directed by seismic engineer stamped drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. Provide Type V-6 isolator for the first three hangers from all equipment specified with spring isolation.
4. All components in a Risk Category IV building are assigned a Component Importance Factor I_p equal to 1.5.

END OF SECTION 220548

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. Comply with NSF 14 for plastic potable-water-service piping.
2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.6 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 Engineer no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Engineer's written permission.

1.7 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type KASTM B 88, Type L, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. 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.

D. 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.

E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 200.

1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

G. PVC, AWWA Pipe: AWWA C900, Class 200, 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, Class 200, 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.

2.2 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" 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.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.

2.4 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 psi
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 psi.
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 psi.
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 psi.
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 psi.

B. UL/FMG, Cast-Iron Gate Valves:

1. UL/FMG, Nonrising-Stem Gate Valves:

a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psi.
3) End Connections: Flanged.

2. OS&Y, Rising-Stem Gate Valves:

a. Description: Iron body and bonnet and bronze seating material.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psi.
3) End Connections: Flanged.

C. Bronze Gate Valves:

1. OS&Y, Rising-Stem Gate Valves:

a. Description: Bronze body and bonnet and bronze stem.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psi.
3) End Connections: Threaded.

2. Nonrising-Stem Gate Valves:

a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.

1) Standard: MSS SP-80.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.

    a. Standard: MSS SP-60.
    b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
    c. Valve: AWWA, cast-iron, nonrising-stem, [metal][resilient] -seated gate valve with one raised face flange mating tapping-sleeve flange.

B. 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 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.

C. 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.

2.6 CORPORATION VALVES AND CURB VALVES

A. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.7 WATER METERS

A. Water meters will be furnished by utility company.

B. Displacement-Type Water Meters:

1. Description: With bronze main case.

    a. Standard: AWWA C700.
    b. Registration: Flow in cubic feet.

C. Compound-Type Water Meters:

1. Description:

    a. Standard: AWWA C702.
    b. Registration: Flow in cubic feet.

2.8 BACKFLOW PREVENTERS

A. City of Jonesboro Specifications.

2.9 WATER METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

2.10 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

    a. Dimension: 24-inch minimum diameter, unless otherwise indicated.

3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

    a. Dimension: 24-inch- minimum diameter, unless otherwise indicated.

4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral

or field-installed bronze ball or clapper-type backwater valve.

2.11 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

    a. Standard: AWWA C502.
    b. Pressure Rating: 250 psig

2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

    a. Standards: UL 246, FMG approved.
    b. Pressure Rating: 250 psig.
    c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
    d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
    e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
    f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

B. Wet-Barrel Fire Hydrants:

1. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550.

    a. Standard: AWWA C503.
    b. Pressure Rating: 150 psig minimum.

2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet.

    a. Standards: UL 246 and FMG approved.
    b. Pressure Rating: 150 psig minimum.
    c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
    d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
    e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
    f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.

    a. Standard: UL 405.
    b. Connections: Two NPS 2-1/2 inlets and one NPS 6 outlet.
    c. Connections: Four NPS 2-1/2 inlets and one NPS 6 outlet.
    d. Connections: Six NPS 2-1/2 inlets and oneNPS 8 outlet.
    e. Inlet Alignment: horizontal.
    f. Finish Including Sleeve: Rough chrome-plated.
    g. Escutcheon Plate Marking: “STANDPIPE."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICAITONS

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, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be soft copper tube, ASTM B 88, Type KASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

F. Underground water-service piping NPS 4 and NPS 6 shall be any of the following:

1. Soft copper tube, ASTM B 88, Type KASTM B 88, Type Lwrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
3. NPS 4 and NPS 6: NPS 6 PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 molded fittings; and gasketed joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

H. Aboveground Water-Service Piping NPS 3/4 to NPS 3 shall be hard copper tube, ASTM B 88, Type K, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

I. Aboveground and vault water-service piping NPS 4 and NPS 6 shall be any of the following:

1. Hard copper tube, ASTM B 88, Type KASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

J. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
2. PE, Class 200, fire-service pipe; molded PE fittings; and heat-fusion joints.
3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

K. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 8 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

L. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 10 shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

M. Aboveground and Vault Combined Water Service and Fire-Service-Main Piping NPS 6 to NPS 10 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 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 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient seated gate valves with valve box.
2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:

    a. Gate Valves, NPS 2 and Smaller: Bronze, rising stem.
    b. Gate Valves, NPS 3 and Larger: AWWA

3.4 PIPING SYSTEMS – COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 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.

C. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Install PE pipe according to ASTM D 2774 and ASTM F 645.

H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

I. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration.

J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

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.

K. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

M. 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.

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. 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. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
5. 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.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 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. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

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. 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.

3.8 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. 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.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 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-type water meters, NPS 3 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.

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 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inchesSTART_SIEND_SI above surface.

3.12 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.13 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.

3.14 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.15 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

D. Connect waste piping from concrete vault drains to sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer piping.

3.16 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 increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.17 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 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.18 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 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless cast-iron soil pipe and fittings.
3. Nonpressure-type transition couplings.
4. Pressure-type pipe couplings.
5. Expansion joints and deflection fittings.
6. Backwater valves.
7. Cleanouts.
8. Encasement for piping.
9. Manholes.
10. Concrete.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Product Certificates: For each type of pipe and fitting.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes and Extra-Heavy class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI-Trademark, Shielded Couplings:

1. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Shielded Couplings:

1. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. 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.

B. 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.

2.4 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 include 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. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-

resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

E. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
2. Horizontal type; with swing check valve and hub-and-spigot ends.
3. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
4. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.6 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): 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.

2.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet.

D. Color: natural.

2.8 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches 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 minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inchminimum 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, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: No Steps.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch 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 ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60 ductile iron unless otherwise indicated.

2.9 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C 150/C 150M, Type II.
2. Fine Aggregate: ASTM C 33/C 33M, sand.
3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi 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.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to 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 following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 48-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105/A21.5:

1. Hub-and-spigot, cast-iron soil pipe.
2. Hubless cast-iron soil pipe and fittings.
3. Expansion joints and deflection fittings.

H. 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.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket 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 PVC corrugated sewer piping according to ASTM D 2321.
5. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
6. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

B. 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 flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Unshielded flexible couplings for pipes of same or slightly different OD.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits

installation.

3.4 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. Form continuous concrete channels and benches between inlets and outlet.

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.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.7 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 deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "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 overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches 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 of concrete for minimum length of 12 inches 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 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.

3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICAITON

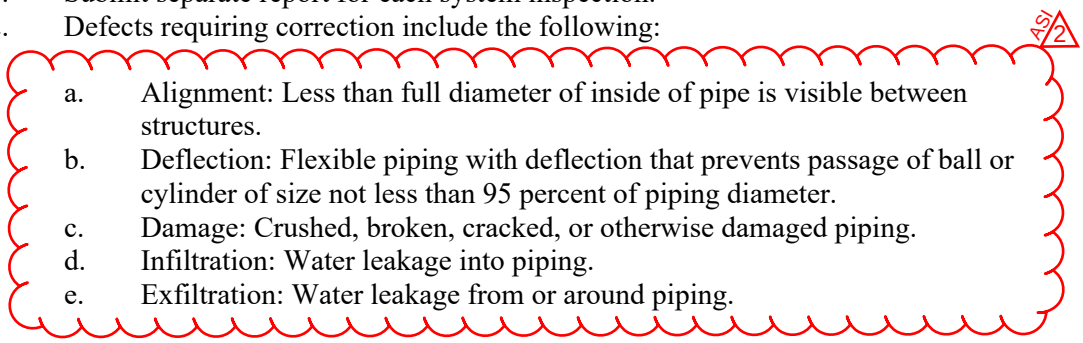
A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches 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 95 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.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foothead of water, and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Manholes: Perform hydraulic test according to ASTM C 969

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.

END OF SECTION

SECTION 221500 - GENERAL SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.01. SUMMARY

A. A. Provide all compressed air materials for installation of complete compressed air system, as required by drawings and these specifications.

PART 2 PRODUCTS

2.01. COMPRESSED AIR PIPING

A. Interior compressed air piping:

1. Piping size 2” and smaller: Schedule 40, Black iron steel pipe.

2. Fittings: Class 125 cast iron, threaded.

2.02. AIR COMPRESSOR SYSTEM

A. Compressor system shall be piped as shown in project plans, details and in accordance with manufacturer’s guidelines.

B. Compressors:

1. Gardner Denver model L37RS rotary screw air compressor

C. Air Dryer:
1. Gardner Denver refrigerated air dryer model RGD-250A4FP

D. Oil Separator:
1. Beko model QP-400, 17.7 gallon

E. 250 gallon receiver tank

F. Line Reactor

2.03. HOSE REELS

A. A. Subject to compliance with requirements, provide product from the following manufacturer.

1. Reelcraft

2. Gardner Denver

3. Graco

PART 3 EXECUTION

3.01. GENERAL

A. Appropriate compression shutoff valve and ground joint unions shall be used at each fixture and piece of equipment to facilitate removal of equipment.

B. Adapters used for screwed valves and any connection to steel shall be insulated to prevent electrolysis.

C. Use dielectric unions where dissimilar metals are joined together.

3.02. INSTALLATION

A. Locate groups of pipes parallel to each other, spaced to permit servicing of valves. Branch takeoffs shall be off of the top of the main, main shall be sloped back towards compressor or shall be provided with a drip leg and cleanout.

B. Install shutoff valves on inlet of each mechanical equipment item and hose outlet.

C. Unless noted otherwise, outlets shall be turned down the wall to 3’ above finished floor. Provide terminal with valve and quick connect fitting. Coordinate fitting with owner.

D. Install compressed air piping level with 0.25 percent slope downward toward drain and plumb.

3.03. VALVE SELECTIONS

A. Steel pipe sizes 2 inch and smaller: threaded.

3.04. VALVE INSTALLATION

A. Use ball and butterfly valves for shut-off duty. Use butterfly valves for throttling duty.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices. Isolation valves shall be installed on branch lines serving two or more pieces of equipment and every 100 feet.

D. Install valves in horizontal piping with stem at or above the center of the pipe.

E. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

F. Align threads at point of assembly.

G. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

H. Install shutoff valve and quick connect fitting at each terminal outlet.

3.05. HANGER AND SUPPORT INSTALLATION

A. Support vertical piping and tubing at base, at each floor, and every 15 feet.

B. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and smaller: 7 feet with 3/8” rod.

2. NPS 1-1/2: 9 feet with 3/8” rod.

3. NPS 2: 10 feet with 3/8” rod.

C. Support piping and tubing not listed above according to MSS SP-69 and manufacturer’s written instructions.

3.06. CLEANING EQUIPMENT

A. Clean and flush system of all dirt, metal chips, sand, and foreign matter. After flushing, remove, clean, and replace all strainer baskets or screens. Inspect each run of each system for completion of joints, supports, accessory items, and obvious leaks.

END OF SECTION

SECTION 23 00 10 - MECHANICAL GENERAL

PART 1 - GENERAL

1.01. CONTRACT DOCUMENTS

A. Drawings are diagrammatic, due to scale, and indicate the general arrangements and geometric relationships of equipment, systems, and services. They are not intended to show or indicate every offset, sequence, device, option, fitting, valve, or accessory. Plan work around building details and other crafts. Do not scale drawings for exact sizes and locations.

B. Contractor shall base all his measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Contractor shall verify all measurements at site and check correctness as related to the work.

C. In case of interferences between trades, Engineer will decide which work is to take precedence regardless of work that might be installed.

1.02. CODES, ORDINANCES, INSPECTIONS AND PERMITS

A. Work is to be executed and inspected in accordance with local and State codes, laws, ordinances, rules and regulations applicable to particular class of work, including the State Mechanical Code, State Plumbing Code, State Gas Code, and State Fire Code. Associated fees shall be paid by the Contractor.

B. Should any part of drawings or specifications be found to be in conflict with applicable codes or ordinances, notify the Engineer, in writing, within 72 hours prior to bid deadline for review and/or correction of bid documents. After project bidding is closed, any discovery of code violations shall be promptly reported to the Engineer. Any work performed in violation of applicable codes or ordinances shall be corrected without additional expense to the Owner or his representatives.

C. Pressure and heating vessels, including hot water storage containers, shall be constructed in compliance with the rules and regulations of the Boiler Inspection Division of the State. All installations of such equipment shall be made by a firm licensed and approved by the Boiler Inspection Division of the State.

D. Facilities shall be installed in compliance with the requirements of the current version of the Americans with Disabilities Act (ADA). Installation of mechanical and plumbing systems including fixtures and control mounting heights, clear knee space, and access clearances shall comply with ADA required dimensions, and as shown on details or schedules when shown.

E. Contractor shall arrange with County, City or State, if City has no ordinances covering work, for complete inspection, paying all charges required. Give proper authority requisite notice relating the work; afford Engineer and authorized inspectors adequate access to the Work for inspection; and be responsible for all violations of law. Upon completion of work, have work inspected, if required, obtaining certificates of inspection and approval

from inspecting agency and deliver certificates to Engineer and Owner.

1.03. REVIEW OF CONTRACT DOCUMENTS AND SITE

A. With the submission of his bid, Contractor shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.

B. Contractor shall acknowledge that he has examined the Plans, Specifications, and Site, and that from his own investigation he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage or materials; availability of labor, water, electric power, roads and uncertainties of weather; the confirmation and condition of the ground; the characters, quality and quantity of subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the Work, especially the prohibited use of Owner's permanent equipment, ductwork, and controls; all federal, state, county, township and municipal laws, ordinances, and regulations particularly those relating to employment of labor, wage rates, and construction methods; and all other matters which can in any way affect the Work or the associated cost of the Work under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

C. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

1.04. USE OF THE OWNER'S EXISITNG AND NEW, PERMANENT HVAC SYSTEM DURING CONSTRUCTION

A. Use of the Owner's existing and currently being installed, permanent HVAC system during Construction is prohibited. Provide temporary means for heating and cooling required by construction activities for curing or drying completed installations or for protecting installed construction from adverse effects of temperature and humidity. Provide temporary dehumidification systems when required to reduce substrate moisture levels required to accommodate installation or application of finishes.

B. Maintain a minimum ambient temperature of 50 DEG. F. in areas where construction is in progress, unless indicated otherwise in the specifications.

C. Prevent dust, fumes, construction debris, and odors from entering existing and newly installed HVAC equipment, ductwork, and control system components. Prior to commencing work, isolate HVAC equipment. Where existing HVAC systems will be affected, isolate existing supply, return, and exhaust ducts by disconnecting ductwork at

point where existing duct shall remain. Cover ends of existing ductwork securely with black plastic material.

D. Newly installed ductwork shall be thoroughly cleaned before installation. Each section that is installed at the end of the day shall have open ends securely covered with black plastic material.

E. Newly installed HVAC equipment shall be securely covered and protected with black plastic material or by other approved method. After installation of air moving equipment, duct connections shall be securely covered with black plastic material. Connections to duct systems shall not be made until final finishes have been installed, areas served are clean, and building is ready for HVAC equipment start-up and use.

F. Securely cover control system components to prevent damage from construction debris, dust, and dirt. Control systems shall not be energized for testing and adjusting until HVAC system start-up.

G. HVAC Equipment, Ductwork, and Control Components contaminated by construction debris, dirt, and construction dust shall not be acceptable and shall be replaced at no additional cost to the Owner. HVAC Equipment, Ductwork, and Control components shall be kept clean throughout construction. Cleaning after an HVAC system has been contaminated shall not be an acceptable alternate to replacement.

1.05. SHOP DRAWINGS AND SUBMITTALS

A. Submit manufacturer's catalog sheets and/or shop drawings covering all phases of work included in this Contract.

B. Arrange submittals in sets and bind in PDF format. Loose sheets are not acceptable. Indicate for each item the location, system, or position where it is to be used, arrange by equipment type and tab sections.

1. Individual submittal packages may be made for plumbing, HVAC, fire protection, test and balance, and controls. The Contractor may submit up to 5 different packages, but where practical provide all submittals in a single PDF.

2. Items which are required to be resubmitted shall come in a single PDF. Approved equipment is not required to be resubmitted.

3. The Contractor is responsible for verification that all items are submitted.

C. Submittals shall bear written certification to the effect that the Contractor has examined them and found them to include all items required to be submitted and to be in accordance with specifications.

D. Submittals are required even though equipment being furnished is exactly as specified.

E. Submittals shall include all data required in individual sections of these specifications.

F. Contractor is responsible for making all submittals required by the specifications for approval. If equipment is delivered or installed without an approved submittal, Contractor

may be required to remove and replace equipment with specified and approved equipment, as directed by the Engineer, without additional cost to the project.

G. Exceptions for Submittals

1. Exceptions to the Specifications or Drawings shall be clearly defined in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the Specifications shall be at the sole discretion of the Engineer.

2. By noting the term "compliance", it shall be understood that the Contractor is in full compliance with the item specified and will provide exactly the same with no deviations.

3. By noting the term "deviation", it shall be understood that the Contractor prefers to provide a different component in lieu of the one specified and in so doing, takes full responsibility for making the equipment work as specified and will provide any and all ancillary components to make the equipment work at no extra cost to the Owner.

4. By noting the term "alternate", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner and in so doing, takes full responsibility for making the equipment work as specified and will provide necessary ancillary components to make the equipment work at no extra cost to the Owner. The alternate method shall be fully described with schematic diagrams and one-line diagrams as applicable.

1.06. SUBSTITUTION OF MATERIALS

A. Final decision as to whether or not a specific piece of equipment meets specifications shall rest with Engineer.

B. Substitution requests will not be accepted prior to bid.

C. Equipment and material manufacturers are referenced in the Plans and Specifications to establish the basis of design and required standards.

D. With each Substitution Request, submit technical data that will fully establish the equality of the proposed substitute product with that listed. Submit completed Substitution Request Form.

E. Substitution Process

1. The naming of a manufacturer's product with the words "basis of design" or the naming of a single manufacturer's product on a drawing equipment schedule, on other drawings, or in the specifications, establishes that specific product as the basis for design. In the absence of any other named acceptable manufacturer's product, provide the "basis of design" product. No substitutions will be accepted.

2. Where other manufacturer's names are listed on the drawings or in the specifications as acceptable in addition to the "basis of design" product, product acceptability for these manufacturers shall be verified via submittal review after the project has bid. No other substitutions will be accepted.

3. Where the words "include but shall not be limited to" or "or equal" are used in addition to a manufacturer's name or a list of manufacturer's names, product acceptability for these manufacturers shall be verified via submittal review after the project has bid.

4. It is the responsibility of the Contractor to provide all of the data necessary to establish acceptability of the product.

5. The submittal for the substitution will be reviewed for conformance with the specifications and equality to the specified products. Full submittals will be required of all equipment. Substitution submittals will be reviewed and shall be rejected if the proposed equipment is found to be different than indicated on the Substitution Request Form, or is found deficient compared to scheduled performance/or specifications.

F. Any proposed substitutions of equipment shall be accompanied by product submittal and shop drawings showing revised equipment layouts, piping diagrams, ductwork drawings and/or wiring diagrams. Where substituted equipment furnished requires use of larger, more, or differently arranged connections, such connections shall be installed to the complete satisfaction of Engineer without additional cost to Owner.

G. The Contractor is responsible for full coordination of all changes required by substituted equipment, including dimensional clearance.

H. The Contractor is responsible for all additional costs of equipment installation, coordination and engineering which results from his substitution. This includes all aspects of the work including architectural, structural, civil, electrical, and mechanical. This also includes costs for the redesign time of Architects and Engineers.

I. Costs associated with dimensional, performance, or other deviations from the "basis of design" equipment, including engineering costs to evaluate such deviations, shall be paid by the Contractor. If a product other than the "basis of design" product is submitted and subsequently rejected during the submittal process, Contractor shall provide the "basis of design" product.

J. Should a substitution be accepted and subsequently proven unsatisfactory for the service intended within the warranty period, the Contractor shall provide the basis of design, or make corrections as directed by Engineer.

1.07. GUARANTY-WARRANTY

A. Guarantee shall include capacity and integrated performance of component parts of various systems in strict accord with the intent and purpose of these specifications. Conduct such tests as herein specified or as may be required by the Engineer to demonstrate capacity and performance ability of various systems to maintain specified

conditions.

B. Compile and assemble the warranties specified in the mechanical division, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment; date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

D. All materials and equipment shall carry a full year's warranty from time Owner accepts building or the date of substantial completion, whichever is earlier, regardless of start-up date of equipment, unless a longer warranty period is specified under other sections. Longer warranty periods for specific items shall be listed in other sections of these specifications.

PART 2 MATERIAL

2.01. MATERIAL AND EQUIPMENT

A. Equipment shall be new, undamaged, and of the same manufacturer except where indicated otherwise.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

D. Protect work and equipment at all times from damage, weather, and entrance of dirt and water. Close pipe and duct openings with caps or plugs during installation.

2.02. ELECTRICAL

A. Contractor shall carefully coordinate voltage and amperage requirements of equipment to be provided. Coordinate with Electrical Contractor prior to equipment order. Any change to electrical systems required by Contractor’s substitutions or uncoordinated equipment needs shall be made without cost to the project.

B. Provide all electrical interlock, control, and other wiring, not covered specifically under the electrical drawings and specifications, for proper operation and control of all equipment specified under this Division of the specifications.

C. Supervise and coordinate all electrical work in connection with mechanical systems.

D. Furnish all motor controllers and contactors, not furnished as part of a motor control center, or by Electrical Division for proper operation of all motors. Submit motor data with submittals.

2.03. ROOF AND FLASHINGS

A. Special care shall be taken on roofs to prevent damage. Promptly repair any damage at no additional expense to the Owner. Comply with bonding requirements of new and existing roofs.

B. Flashings are not covered by this section. Refer to Architectural Division.

2.04. ACCESS PANELS

A. Provide access panels in all floors, walls, and plaster and non-lay-in type ceilings as required or as indicated to service devices in piping requiring access, controls, devices in ductwork requiring access, and other system components requiring access for service or regular maintenance. Closely coordinate requirements for access doors before bidding.

B. Access doors shall be "Milcor" type appropriate for the construction involved.

C. Size and type shall be as required for proper service and/or as may be directed by the Engineer. Minimum size to be 24” x 24”.

2.05. ASBESTOS AND OTHER HAZARDOUS OR TOXIC MATERIALS

A. No Asbestos containing materials shall be used on this project.

B. Contractor is responsible for his own means and methods of safety where Hazardous or Toxic materials are use for the installation of his work. All work shall comply with state and federal regulations.

C. Contractor shall protect the Owner's facility and employees from conditions generated by his work.

D. In the event that a potentially hazardous material is discovered during the course of the work, Contractor shall stop work immediately, and provide for the safety of his employees and other occupants. He shall make proper notifications as required by his contract and by law.

2.06. CONCRETE

A. Concrete materials and installations indicated on the drawings for curbs, pads, and supports for mechanical equipment shall be provided as part of the contract.

B. Comply with other architectural and structural portions of the specifications for materials and methods.

C. Concrete.

1. Concrete shall be commercial grade containing Portland cement, aggregates, clean water, and mix ratios suitable for the loads, and site conditions.

2. Concrete shall be 3,000 psi class indoors and 3,500 psi class outdoors unless noted otherwise.

3. Comply with ACI standards for cold and hot weather applications.

D. Installation

1. Use rigid and smooth forms to prevent visible defects and deflections in the work. Use form compound to prevent concrete bonding to the forms.

2. Provide chamfered corners on the tops of curbs.

3. Reinforce pads and curbs with steel reinforcing bars minimum size number 3, welded wire fabric, or as indicated on the drawings. Set the reinforcing depth within the concrete for optimum strength for the application.

4. Provide equipment pads of sizes indicated and at least large enough to extend past the mechanical equipment 6" on all sides. Minimum height 6” unless otherwise noted.

5. Pour pads integral with the floor slab, isolate from the floor slab, or dowel the pads, as indicated on the drawings.

6. Grout all voids with high strength grout mixture.

7. Installation of the pads shall be coordinated so that the concrete has set and the strength is suitable for installation of the equipment.

8. Set anchor bolts where indicated by either equipment manufacturer or Structural Engineer.

9. Brush-finish equipment pads.

2.07. LOCAL SITE CONDITIONS

A. Before bidding, make complete investigation at site in order to be informed as to location of utilities and as to conditions under which work is to be performed. Utility locations shown were obtained from surveys and/or local utility companies and are offered as a general guide only and are not to be assured accurate.

B. Make determination of soil conditions before bidding. These specifications and accompanying drawings in no way imply condition of soil to be encountered.

2.08. EXCAVATION, TRENCHING AND BACKFILLING

A. Excavation, trenching, and backfilling in connection with the mechanical system, to a point 5'-0" outside the building, is included as part of this Division, unless indicated otherwise.

B. Excavation required shall be done as part of the contract price regardless of any implied conditions on the drawings or in these specifications.

C. Excavation to have 12" minimum and 24" maximum clearance on all sides. Do not carry

excavation below required level unless indicated otherwise on the drawings. Excess excavation below required level shall be backfilled at no expense to Owner with earth, sand, gravel, or concrete, as directed by Engineer and thoroughly compacted. Remove any unstable soil and replace with gravel, crushed stone, or clean sand and thoroughly compact. Engineer will determine the depth of removal of any unstable soil encountered. Grade ground adjacent to excavation to prevent water from running into excavation. Remove accumulated water in the excavation.

D. Banks of trenches shall be vertical or as shown on the drawings. Width of trench shall be 5" minimum, 8" maximum on each side of pipe bell. Excavate bell holes accurately to size by hand. In rock, excavations shall be carried 8" below bottom of pipe. Use loose earth or gravel for backfill and tamp thoroughly.

E. Bracing, sheathing, and shoring shall be performed as necessary to complete and protect excavations indicated on the drawings, as required for safety, as directed by Engineer, and to conform to governing laws and state and federal regulations. Comply with OSHA Regulations.

F. After piping installation, inspection, testing, and approval by governing agency; backfill trenches with clean, stable soil free from stones. Place backfill in 4" layers, tamped under and around pipe and conduit to height of at least 2' above pipe. Tamping shall be done in such manner as not to disturb underlying work. Remainder of trenches and excavations shall be backfilled with clean, stable earth, deposited in 8" layers and brought up to rough grade, with each layer compacted to density of surrounding soil. Remove sheathing and shoring as backfill is placed and fill space with dry sand. Compaction tests may be required by the Engineer, with the costs paid by the Contractor.

G. Underground piping shall be marked with metallic marking tape inserted in the trench a minimum of 12" below grade and a minimum of 12" above mains.

H. Replace existing appurtenances removed or damaged in connection with work, and restore to original conditions, unless directed otherwise.

2.09. MECHANICAL INSTALLATIONS:

A. Coordinate mechanical equipment and material installation with other building components and other trades. Investigate each space in the structure through which mechanical equipment furnished under these specifications must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. Verify all dimensions by field measurements. By ordering equipment, Contractor assumes responsibility for the installation and orientation of equipment in the available space.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment

for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Fit equipment, pipe, and duct into the available spaces in the building and introduce into the building, at a time, and in a manner, as not to damage the structure. Install ductwork and piping to provide the maximum possible clear height underneath.

G. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

H. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

I. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, and other installations.

K. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

L. Do not support material or equipment of other trades from piping or ductwork.

M. Do not use equipment, piping, or ductwork as scaffolding, scaffolding support, or as other means to access the work. Damaged systems and components shall be repaired or replaced in accordance with the full satisfaction of the Owner and Engineer.

N. Core drill piping penetrations of concrete walls, floors, and other concrete structures.

O. Equipment locations shown on the drawings are approximate. Final locations shall be established and determined in the field to best utilize available space.

P. Replace architectural features removed or damaged during the course of the work.

Q. Maintain fire assembly ratings as dictated by authorities having jurisdiction. Seal around penetrations through UL rated assemblies, fire, and smoke walls.

R. Fully seal around duct or pipe routed through exterior walls.

2.10. EQUIPMENT CONNECTIONS

A. Each equipment item with drain connections shall be provided with a properly-sized drain run to the nearest floor drain or as directed.

B. Rough-in and make final required connections to equipment, furnished under other Divisions of the Specifications or by the Owner.

1. Provide necessary labor and materials for a complete installation. Trap and vent drainage connections as required.

2. If equipment or fixtures furnished by others are not delivered prior to final acceptance, services shall be capped or plugged at walls or floor as directed, ready for future connection.

C. No equipment or fixture shall be "roughed-in" until proper rough-in drawings are provided to the installer.

D. Extend grease fittings to accessible locations.

2.11. CUTTING AND PATCHING

A. Provide cutting and patching required to perform the mechanical work, when alteration, repair, renovation, or addition, to existing construction is specified or required for new work.

B. Cutting of structural members will not be permitted except through explicit instructions from the Engineer. Reinforcing will be required where members are cut.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching required to:

1. Uncover Work to provide for installation of ill-timed Work.

2. Remove and replace defective Work.

3. Remove and replace Work not confirming to requirements of the Contract Documents.

4. Remove samples of installed Work as specified for testing.

5. Upon written instructions from Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.

2.12. GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

I. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5,000-psi (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.13. SEISMIC

A. Mechanical systems shall be installed in conformance with the requirements of the state and federal codes and regulations for Seismic considerations, as specified and noted on the drawings.

B. All seismic restraining and snubbing devices shall be manufactured specifically for this duty. Devices constructed by the Contractor will not be accepted.

C. Contractor shall be responsible for the design and installation of the restraining and snubbing systems based on the criteria included on the drawings and in the specifications, and the actual equipment, and locations of installation.

2.14. START UP, TESTING, AND ADJUSTING

A. Contractor shall include adequate time in construction schedule for HVAC system start-up; testing, adjusting, and balancing; and control system installation, programming, testing, and commissioning.

B. Each and every phase of the plumbing, air conditioning, heating and ventilating systems shall be operated separately, or in conjunction, one with the other, for a sufficient period of time to demonstrate to the entire satisfaction of the Engineer the ability of the systems to meet the capacity and the performance requirements while maintaining design conditions, in accordance with the intent of these specifications.

C. Previous to any performance tests, the Contractor shall have set and adjusted valves, dampers, motors, controllers, thermostats, and other items as are necessary to properly balance phases of the mechanical systems and shall have the systems operating and maintaining design temperatures, humidity, and air circulation throughout all areas of the

building.

D. See other sections of these specifications for other possible records and tests to be made.

E. During the first-year warranty, the Contractor may be required to make some or all of the readings above to assure system is functioning properly through the various seasons. Contractor shall make additional adjustments as required.

2.15. PAINTING

A. Provide mechanical equipment with factory painted finish. Where factory finish is damaged during handling and installation, use touch-up paint of same type and color as original paint. Where extensive refinishing of factory applied finishes are required, equipment shall be repainted by the factory.

B. All uninsulated, ferrous equipment, tanks, pipes, fittings, pipe hangers, supports, miscellaneous steel, and ironwork without factory finish shall be primed and painted. Do not paint galvanized hanger rods or galvanized duct straps.

1. Where exposed to view, except in mechanical spaces, color shall be as selected by the Architect.

2. Where located in mechanical spaces or in areas not exposed to view, color shall be as directed by Owner's representative to match Owner's existing color schedule. In the absence of an Owner's color schedule, color shall be black.

C. All insulated mechanical equipment, tanks, and piping not provided with a factory finish shall be painted.

1. Where exposed to view, except in mechanical spaces, color shall be as selected by the Architect.

2. Where located in mechanical spaces or in areas not exposed to view, color shall be as directed by Owner's representative to match Owner's existing color schedule. In the absence of an Owner's color schedule, color shall be black.

D. For uninsulated material to be painted, prime with one coat of alkyd primer and paint with two coats of alkyd enamel gloss. Paint shall be suitable for the environmental and temperature conditions where material is installed.

E. Paint insulated material with two coats of alkyd enamel gloss. Paint shall be suitable for the environmental and temperature conditions where material is installed.

F. Prepare surfaces for painting in accordance with the paint manufacturer's requirements. Remove or protect portions of the work which are not to be painted.

G. Apply primer coat(s) of paint as recommended by the paint manufacturer.

H. Apply final coat(s) of paint as recommended by the paint manufacturer. Apply paint by brush or roller as dictated by the surface to be painted. Paint should have a smooth appearance without cloudiness, spotting, marks, runs, or other surface imperfections.

I. Clean-up the area of materials, waste, and rubbish. Clean splattered surfaces.

J. Protect the work from damage. Touch-up and restore defaced painted surfaces at the end of the project.

2.16. NOISE: Contractor shall isolate pipes, ductwork, equipment, and other items to insure no additional noise is generated or transmitted to the building when systems are in operation.

2.17. ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment. See Paragraph 3.11 for painting.

B. Field Welding: Comply with AWS D1.1.

2.18. OPERATION INSTRUCTIONS

A. Contractor shall provide bound manuals containing complete repair parts' lists, and operating service and maintenance instructions for equipment provided. The manual shall include:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing and instructions and lubrication charts and schedules.

B. Contractor shall carefully instruct the Owner's operations personnel during the adjustment and testing period of the equipment for such length of time as may be necessary to thoroughly familiarize them with the proper care, operation, and maintenance of the equipment.

C. Contractor shall turn special tools, maintenance items, keys, other devices and materials required to operate or maintain the systems over to the Owner.

2.19. CLEAN UP

A. Do not allow waste material or rubbish to accumulate in or about jobsite. Clean work areas daily.

B. At completion of work, remove rubbish, tools, scaffolding, and surplus materials from and about building, leaving work clean and ready for use without further cleaning required. Clean equipment, piping, valves, fixtures, and fittings of grease, metal cuttings, insulation cement, dust, dirt, paper labels, and other materials that are not part of the final finish.

C. Any discoloration or other damage to parts of building, its finish or furnishings due to failure to properly clean or keep mechanical systems clean shall be repaired without cost to Owner.

2.20. NAMEPLATE DATA:

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

B. Locate nameplates in an accessible location. Where manufacturer's name plate is not stamped or engraved, provide additional heavy gauge aluminum or brass, stamped or engraved nameplate.

C. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.

2.21. RECORD DOCUMENTS

A. At completion of this project, the Contractor shall provide Engineer with one set of "red lined" design drawings and specification showing all Work installed by him.

B. These documents shall incorporate all changes made in the course of the project so as to enable the Owner to properly maintain, operate, and repair both exposed and concealed work. The redlines shall indicate changes:

1. Made by Contractor.

2. Addendum Items.

3. Change Orders.

4. Substitutions.

C. Drawings and specifications shall be updated during the progress of the work and kept at the job site.

D. Record Prints: Maintain one set of blue-line or black-line prints of the Contract Drawings, Submittals, and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2.22. FINAL PROJECT OBSERVATION: The final project observation shall not be made until the following items have been assembled and approved as indicated in other sections of the specifications.

A. Certificate of acceptance from local inspecting authorities.

B. Letter of compliance from the Controls Systems Provider indicating that the system is complete, fully operational, and installed as specified by manufacturer's certified or licensed individuals.

C. Test and Balance report.

D. Owner's Operations and Maintenance manual.

E. Copies of bonds, insurance certificates, waivers, affidavits, warranties and guarantees, and other documents required in the specifications signed and ready for appropriate action.

F. Written notification from the Contractor that the work is complete and ready for final observation and the above documents are completed and available

G. Other documentation which may be required by the Engineer.

2.23. PROJECT CLOSEOUT

A. The final mechanical systems closeout shall not be completed until the Contractor has completed his work and submitted the documents required by Division 1 portions of the specifications. In addition, the following work items and specific mechanical documents described in other portions of this specification section shall also be submitted and approved:

1. Record drawings.

2. Record specifications.

3. Guarantee and Warranties.

4. Operating and Maintenance Manuals (O&M). O&M Manuals shall also be provided to the Owner in duplicate. Manuals shall contain approved shop drawings, operations and maintenance instructions, parts manuals for HVAC equipment, an accurate set of design plans showing all construction revisions to the design set, and a copy of the test and balance report.

5. Final clean up.

6. Final Test and Balance Reports with startup logs.

7. Pipe and Equipment Identification.

8. Pipe test certifications.

9. Water treatment analysis and application.

10. Bonds, Insurance Certificates, Waivers, Affidavits, and other documents required in the specifications signed and ready for appropriate action.

11. Other items which may be required by the Engineer.

B. Confirm in writing that specified training specified has been completed with the Owner.

C. Confirm in writing that specified demonstrations have been completed with the Owner.

D. Confirm that test and balance is complete.

END OF SECTION

SECTION 23 0015 - FIRESTOPPING AND SMOKE STOPPING

PART 1 - GENERAL

1.01. SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.

B. Scope:

1. The scope of the work shall include the mechanical systems, HVAC piping and ductwork, plumbing piping, fire protection piping, and other systems installed by the contractor.

1.02. 1.02 REFERENCES

A. Underwriters Laboratories

1. U.L. Fire Resistant Directory

a. Through-penetration firestop devices (XHCR)

b. Fire resistance ratings (BXUV)

c. Through-penetration firestop systems (XHEZ)

d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards:

1. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.03. 1.03 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time rated fire walls, time rated ceiling/floor assemblies, and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

F. Sleeve: Metal fabrication or pipe section extending through thickness off barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

1.04. SYSTEM DESCRIPTION

A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

1.05. SUBMITTALS

A. Submit in accordance with general conditions unless otherwise indicated.

B. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication

2. Manufacturer's installation instructions.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL System number, or UL classified devices.

2. Manufacturer or manufacturers' representative shall provide qualified engineering judgements and drawings relating to non-standard applications as needed.

D. Quality control submittals:

1. Statement of qualifications.

E. Applicators' qualifications statement:

1. List past projects indicating required experience.

1.06. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.07. REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

1.08. ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

D. Furnish forced air ventilation during installation if required by manufacturer.

E. Keep flammable materials away from sparks or flame.

F. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

G. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.09. SEQUENCING

A. Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

1.10. QUALITY ASSURANCE

A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.

2. At least 2 years' experience with systems.

3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

1.11. DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instruction.

1.12. PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

1.13. GUARANTEE

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

PART 2 PRODUCTS

2.01. THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems or devices listed in the U.L. Fire Resistance Director under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.

1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.

2. Acceptable manufacturers and products: Those listed in the U.L. Fire Resistance directory for the U.L. System involved and as further defined in Part 3.06 of this section.

3. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer.

4. Products shall be 3M firestopping products and systems or equal.

2.02. SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-Penetration Smoke-Stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

B. Construction-Gap Smoke-Stopping: Any system complying with the requirements for construction-gap firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.03. MATERIALS

A. Firestopping Material: Single or multiple component silicone elastomeric rubber type

foam compound mixed with incombustible non-asbestos ceramic fibers.

B. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

2.04. 2.04 ACCESSORIE

A. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.

B. Forming materials: As classified under Category XHKU in the U.L. Fire Resistance Directory.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.02. SURFACE PREPARATION

A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.03. INSTALLATION

A. Apply primer and materials in accordance with manufacturer’s instructions.

B. Install penetration seal materials in accordance with printed instruction of the U.L. Fire Resistance Directory and in accordance with manufacturer’s instruction.

C. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

D. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.

E. Apply firestopping material in sufficient thickness to achieve rating and to a uniform density and texture.

F. Protect materials from damage on surfaces subject to traffic.

G. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

H. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges - installed in accordance with fire damper manufacturer's recommendations.

I. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application. See U.L. Fire Resistance Directory.

J. Install smoke stopping as specified for firestopping.

K. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical 12-inch-wide fiber dams for full thickness and height of air cavity at maximum 15-foot intervals.

L. Dam material to remain.

3.04. FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.05. ADJUSTING AND CLEANING

A. Clean adjacent surfaces of firestopping materials.

B. Clean up spills of liquid components.

C. Neatly cut and trim materials as required.

D. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.06. PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.07. SYSTEMS AND APPLICATION

A. The installation shall be as required by manufacturer for type of construction, Type of U.L. systems, type of penetration, and type of fire stopping system.

END OF SECTION

SECTION 23 00 30

ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:

A. This section specifies the basic requirements for electrical components which are to be provided for operation of mechanical equipment. These components include, but are not limited to, motors, starters, and disconnect switches when indicated, furnished as an integral part of packaged mechanical equipment, or furnished separately for mechanical equipment.

B. Furnish all motor controllers and contactors, not furnished as part of a motor control center, for proper operation of all motors.

C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections and scheduled on the drawings.

1.02 REFERENCES:

A. NEMA Standards MG 1: Motors and Generators.

B. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment.

D. NEMA Standard KS 1: Enclosed Switches.

E. National Electric Code (NFPA 70).

1.03 SUBMITTALS:

A. Separate submittal is not required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.04 QUALITY ASSURANCE:

A. Electrical components and materials shall be UL labeled.

B. The electrical work shall comply with the National Electric Code.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Equipment shall be by same manufacturer, except those items furnished by an equipment manufacturer as an integral part of his equipment. Where possible the equipment shall be by the same manufacturer specified in Division 16.

2.02 MOTORS: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

A. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

B. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

C. 2-speed motors shall have 2 separate windings on poly-phase motors.

D. Temperature Rating: Rated for 40 degrees C. environment with maximum 90 degree C rise for continuous duty at full load (Class B insulation).

E. Starting Capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly spaced starts per hour for manually controlled motors.

F. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

G. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

1. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.

2. Bearings:

a. Ball or roller bearings with inner and outer shaft seals.

b. Re-greaseable, except permanently sealed where motor is normally inaccessible for regular maintenance.

c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.

3. Enclosure Type:

a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.

b. Guarded drip-proof motors where exposed to contact by employees or building

occupants.

c. Weather protected Type I for outdoor use, Type II where not housed.

4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

5. Noise Rating: "Quiet".

6. Efficiency:

a. Motor shall comply with the efficiency requirements of the Energy Independence and Security Act of 2007.

b. Motors smaller than 1 HP shall have minimum full load efficiencies levels per NEMA Standards.

c. Motors 1 HP and larger shall be premium efficiency.

7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

2.03 STARTERS, ELECTRICAL DEVICES, AND WIRING:

A. Motor Starter Characteristics:

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R or NEMA 12 with conduit hubs installed by contractor, or units in hazardous locations which shall have NEC proper class and division.

2. Type and size of starter shall conform to adopted standards and recommended practices of the National Electric Code and Underwriters' Laboratories.

B. Manual Switches: Manual switches shall have:

1. Pilot lights and extra positions for multi-speed motors.

2. Overload protection: Melting alloy type thermal overload relays.

3. Manual starters / switches are to be used on fractional horsepower motors only.

C. Magnetic Starters:

1. Momentary contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

2. Trip-free thermal overload relays, each phase.

3. Interlocks, witches and similar devices as required for coordination with control

requirements of controls sections.

4. Built-in 120-volt control circuit transformer, with 2 primary and one secondary fuse, where service exceeds 240 volts. Fuses sized to carry holding coil circuit and other connected devices.

5. Externally operated manual reset.

6. Under-voltage release or protection (3-wire control).

7. Branch circuit protection shall meet type 2 coordination protection.

8. A hand-off-auto selector switch shall be provided in addition to start-stop buttons for all devices being controlled automatically.

9. Phase loss relay.

   a. Provide protective relays with DPDT 600V rated contacts, locking potentiometer undervoltage adjustment, and LED indicating light at each starter for motors greater than 5 HP. Equal to Square D Class 8430, Type MPD, mounted in suitable enclosure.

D. Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Heater Contactors:

1. Contactors for resistance heat shall be by same manufacturer as starters unless furnished with heaters. Contactors shall be of the magnetic type and mounted in NEMA Type 1 general purpose enclosure. Contactors shall carry a UL listing and shall be rated for 100,000 cycles.

F. Disconnect Switches:

1. Fusible Switches: Fused, each phase; heavy duty; horsepower rated; non-teasible, quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "open" position; arc quenchers; capacity and characteristics as indicated.

2. Non-fusible Switches: For equipment less than 1 horsepower, switches shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment 1 horsepower and larger, switches shall be the same as fusible type.

2.04 CAPACITORS:

A. Features:

1. Individual unit cells, all welded steel housing, each capacitor internally fused, non-flammable synthetic liquid impregnant, craft tissue insulation, and aluminum foil electrodes.

2. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger that have an uncorrected power factor of less than 85 percent at rated load.

PART 3 - EXECUTION

3.01 GENERAL

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters and wiring devices which have not been factory-installed on equipment unit to electrical installer for installation.

C. Install starters and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate for proper operation access, including visibility, and for safety. Do not cover equipment data or informational tags when device is to be mounted on equipment.

D. Install control connections for motors to comply with NEC and applicable provisions of Electrical. Install equipment grounding except where non-grounded isolation of motor is indicated.

E. Connect protective relays to line side lugs of the motor starter and wire control contacts into motor starter circuit.

F. Label starters with engraved plastic nameplate describing the equipment served, e.g., "A.C. Unit No. 1". Nameplates shall be U.V. stabilized for use indoor / outdoor. Attach nameplates with clear silicone sealant.

END OF SECTION

SECTION 23 0060

BASIC PIPING

PART 1 - GENERAL

1.01. THERMAL EXPANSION:

A. Swing joints, turns, expansion loops, and long offsets shall be provided where necessary to allow for expansion and contraction. Pipe, fittings, or equipment damaged during the warranty period due to thermal expansion shall be replaced at no additional cost to the Owner.

1.02. NOISE CONTROL:

A. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise.

1.03. CROSS CONNECTIONS:

A. No piping shall be installed that will provide a cross-connection between potable water system and a polluted supply.

1.04. SUBMITTALS

A. Product Data: Submit catalog cut sheets and specifications for each type of pipe, tube, and fitting. Submit pipe schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Except for hub and spigot, clay, and similar piping, provide factory applied end caps on all pipe and tubing to prevent damage, and dirt and moisture entry. Maintain end caps through shipping, storage, and handling.

B. Where possible, store pipe, tube, flanges, and fittings inside and protected from the weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

1.06. QUALITY ASSURANCE

A. Qualify and certify welding and brazing procedures, equipment, and operators in accordance with ASME codes and standards for shop and job site work.

B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

C. Welding procedures and testing shall comply with ANSI Standard B31.1.

D. Soldering and brazing procedures and testing shall comply with ANSI Standard B31.9. Comply with ANSI Standard B31.5 for refrigerant piping.

PART 2 - PRODUCTS

2.01. MATERIALS:

A. Refer to specific piping specification sections for materials to be used on the various piping systems.

B. Materials shall be manufactured by firms whose products of types and sizes required for this project have been in satisfactory use in similar service for 5 years.

C. All materials shall be new and undamaged.

D. For corrosive environments all bare copper piping shall be provided with special Heresite coating even if located within outdoor equipment.

2.02. CONDENSATE PIPE:

A. Piping shall be type M hard drawn copper, or DWV copper.

1. Fittings: Wrought copper.

2. Provide with traps and vents.

B. Piping shall be SCH 40 PVC

1. Fittings: glued joints.

2. Provide with traps and vents.

3. Not to be used in return air plenums.

2.03. REFRIGERANT PIPE, INCLUDING LIQUID AND HOT GAS LINES: hard drawn copper, Type "L" (degreased).

A. Soft copper will be permitted when sleeving below grade or installing in wall to eliminate fittings. Soft copper may also be installed on units less than 1 1/2 tons.

B. Do not run refrigerant lines thru return air plenum unless approved by engineer.

C. Do not run refrigerant piping underground.

2.04. JOINING MATERIALS:

A. Refer to specific piping specification sections for special joining materials not list below.

B. Pipe Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch maximum thickness, unless other thickness or specific material is indicated.

2. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

3. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: approximately 95 percent tin and 5 percent silver, with 0.1 percent lead content.

2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.1 percent maximum lead content.

3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.1 percent maximum lead content.

4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.1 percent maximum lead content.

5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.2 percent maximum lead content.

E. Brazing Filler Metals:

1. BcuP Series: Copper-phosphorus alloys.

2. Bag1: Silver Alloy.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements: Manufacturer's standard solvent cements for the following:

1. ABS Piping: ASTM D 2235.

2. CPVC Piping: ASTM F 493.

3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

4. PVC to ABS Piping Transition: ASTM D 3138.

H. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

J. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.

2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.

3. Gaskets: Rubber.

4. Bolts and Nuts: AWWA C111.

5. Finish: Enamel Paint.

K. Dielectric Fittings

1. Provide dielectric connection at all connections between pipe materials of differing types whether indicated on plans or not.

2. Insulating Material: Suitable for system fluid, pressure, and temperature.

3. Dielectric Unions: Factory fabricated, union assembly, for 250-psig minimum working pressure at 180 °F.

4. Dielectric flanges: Factory fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

5. Dielectric-Flange Insulation Kits: Field assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.

6. Dielectric couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F,

7. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F.

2.05. PIPE ESCUTCHEONS:

A. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floor, walls, or ceilings; and pipe sleeve extension, if any. Furnish solid pipe escutcheons with nickel or chrome finish for occupied areas. Prime paint finish

for unoccupied areas. Split hinge type is not acceptable in occupied areas, except on existing piping.

B. For waterproof floors and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons.

2.06. PIPE SLEEVES:

A. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" diameter and smaller, 20 gauge; 4" to 6" diameter, 16 gauge; over 6" diameter, 14 gauge.

B. Steel-Pipe: Fabricate from ASTM A 53, Grade A, Schedule 40 galvanized steel pipe.

C. Iron-Pipe: Fabricate from cast-iron or ductile iron pipe; cast-iron sleeve to be same wall thickness as equivalent ductile iron pipe.

2.07. SLEEVE SEALS:

A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and electrical insulation. Thunderline, "Link Seal" or equal.

B. Fire Protection Mechanical Sleeve Seals: Three (3) hour rated modular mechanical type, consisting of interlocking fire resistant silicone rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and fire resistant seal. Thunderline, "Link Seal" or equal.

C. Fire Protection Sealant

1. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies and provide a fire rating equal to that of construction being penetrated.

2. All firestop materials and methods shall conform to applicable governing codes having local jurisdiction, whether approved by submittal or not.

3. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar independently tested system designs will be submitted to local authorities having jurisdiction for their review and approval prior to installation.

D. Elastomeric Joint Sealant: Type S, Grade NS, Class 25, Use O, neutral-curing, silicone sealant unless otherwise indicated.

E. Grout: Nonshrink, nonmetallic, hydraulic cement grout, ASTM C 1107, Grade B. Post hardening, volume adjusting, dry, nonstaining, noncorrosive, and nongaseous recommended for interior and exterior applications. 5000 psig, 28 day strength.

PART 3 - EXECUTION

3.01. GENERAL:

A. Install piping as described below, unless indicated otherwise in the individual piping sections. See the individual piping sections for unique piping installation requirements.

B. Exposed lines are to be run parallel with, or perpendicular to, building lines and wherever possible shall be grouped together for easy service and identification. Lines requiring a definite grade for drainage shall have precedence in routing over all other lines. Wherever possible, horizontal and vertical lines shall be held as close as possible to walls, ceilings, struts, and structural members to occupy minimum space consistent with the proper requirements for insulation, expansion, removal of pipe, and access to valves. Except in mechanical spaces, piping shall not be run exposed in finished area of buildings unless otherwise noted.

C. General Locations and Arrangements: Drawings including plans, schematics, and diagrams indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

F. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, and below grade or floors, unless indicated otherwise.

G. Install piping at indicated slopes and as prescribed by Code.

H. Install components with pressure rating equal to or greater than system operating pressure.

I. Install piping free of sags and bends.

J. Install piping with sufficient space above removable ceiling panels to allow for panel removal.

K. Install drains at low points in mains, risers, and branch lines consisting of a branch fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

L. Piping shall be worked into place without springing and/or forcing. Arrange piping so that it does not interfere with removal of other equipment or devices, nor to block access to doors, windows, manholes, or other access openings.

M. All piping shall be installed so as to avoid liquid or air pockets throughout the work. Piping shall be erected and pitched to insure proper draining. Provide air vents and drain traps where indicated and as required.

N. All exposed plumbing fixture supplies and stops shall be chrome-plated.

O. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. If piping must be run through electrical spaces, comply with NFPA 70 for access clearance requirements for electrical equipment. Install drip pan under piping which must be run through electrical spaces. Pan drain shall be run at exterior or sanitary, as permitted by Code.

P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.

Q. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

3.02. ASSEMBLY:

A. All pipes shall be cut square and shall have burr and cutting slag removed by reaming or other cleaning methods.

B. Remove scale, slag, dirt, and debris from both inside and outside of piping and fittings before assembly.

C. Unions or flanges shall be used at all equipment connections to facilitate dismantling.

D. All joints and changes of direction shall be made with standard fittings. Reducers shall be used at pipe size changes.

E. Where required to prevent electrolysis and corrosion, dielectric fittings and couplings, or brass or bronze fittings or valves, shall be used between copper and steel piping. Provide insulating coupling on all underground metallic utility lines where they connect to building.

F. Nipples shall be of same material and composition as pipe on which they are installed, and shall be extra heavy when unthreaded shoulder is less than 1-1/2". No running thread nipples will be permitted. Minimum exposed shoulder of any nipple shall not be less than 3/4".

G. Joints between steel or copper pipe and cast iron shall be made with caulking ferrules.

H. Cast iron soil pipe and fittings shall be assembled with approved molded push-on type gaskets. Approved no-hub pipe may be used where applicable.

I. Galvanized steel pipe shall be assembled with galvanized screwed fittings.

J. Black steel pipe shall be assembled with screwed or welded fittings.

K. Copper pipe shall be assembled with wrought copper fittings. Use Alloy Sn95 (95/5) solder as a minimum. See specific piping sections for other requirements.

L. For steel piping, use new forged tees for branch connections to main in new piping systems. Forged tees or forged weld-o-lets shall be used for branch connections to existing mains.

M. Soldered Joints: Construct joints according to AWS's "Soldering Manual"; or CDA's "Copper Tube Handbook".

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook".

O. 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. Use appropriate tape or thread compound as required unless dry threading is specified.

P. Welded Joints: Construct joints according to AWS D10.12 using qualified processes and welding operators.

Q. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

R. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: ASTM D 2235 and ASTM D 2661.

3. CPVC Piping: ASTM D 2846 and ASTM F 493.

4. PVC Pressure Piping: ASTM D 2672.

5. PVC Nonpressure Piping: ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

3.03. FITTINGS AND ACCESSORIES:

A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

B. Install unions adjacent to each valve at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.

C. Install flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

D. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through walls, partitions, and ceilings where penetration is exposed to view; and on the exterior of the building.

3.04. SUPPORTS:

A. Provide an adequate pipe suspension system in accordance with recognized engineering practices, using, where possible, standard, commercially accepted pipe hangers and accessories. No piping shall be supported by, or from, hangers supporting electrical conduit.

3.05. SLEEVES

A. Install pipe sleeves of types indicated where piping passes through walls, floors, slabs, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as directed by the Structural Engineer.

B. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Where insulation includes vapor barrier jacket, provide sleeve with sufficient clearance for insulation.

C. Install length of sleeve equal to the thickness of construction penetrated, and finished flush to surface; except extend floor sleeves 1 inch above level floor finish.

D. Sleeves are not required for core-drilled holes.

E. Permanent sleeves are not required for holes formed by removable plastic sleeves.

F. Provide temporary support of sleeves during placement of concrete and other work around sleeves. Provide temporary closure to prevent concrete and other materials from entering sleeves.

G. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings for pipe diameter including insulation (if any) of 6 inches and larger.

H. Install iron-pipe sleeves at exterior penetrations, both above and below grade and for slab on grade penetrations.

I. Install steel-pipe sleeves at interior partitions for pipe diameter including insulation (if any) of less than 6 inches.

J. Seal voids between outside of sleeve and construction with nonshrink, nonmetallic grout.

K. Sleeves Seals:

1. Provide sleeve seals for core drilled holes and holes made using removable plastic sleeves.

2. Provide mechanical sleeve seals for exterior wall, floor, and slab on grade applications. Install in accordance with manufacturer's recommendations for a water tight seal. Except for slab on grade and below grade wall penetrations, elastomeric joint sealants may be used in lieu of mechanical sleeve seals.

3. Provide fire mechanical sleeves seals for penetrations of rated walls, slabs, floors, and ceilings. Fire protection sealants complying with all authorities having jurisdiction may be used in lieu of mechanical type seals.

4. Sleeve seals are not required in non-rated interior partitions and ceilings.

3.06. CLEANING, FLUSHING, INSPECTION:

A. Clean exterior surfaces of installed piping systems and prepare for application of coating and painting (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each length for completion, supports, and accessories.

3.07. TESTING:

A. Test all piping systems as hereinafter specified and furnish to the Engineer copies of the test reports signed by the Contractor.

B. Piping located underground shall be tested and inspected by the governing agency before backfilling.

C. Equipment and personnel required for tests shall be furnished without additional cost. Testing equipment shall be as required for particular test, with all equipment and gauges accurate and in good working order.

D. Equipment subject to damage at given test pressure shall be removed from line before pressure is applied. Use proper plugs or caps.

E. Repair piping system sections which fail the required test, by disassembly and re-installation, using new materials. Do not use chemicals, stop-leak, mastics, or other temporary repair methods. Retest the system.

F. Drain test water after testing and repair work has been completed.

G. See specific piping system sections for test pressure, duration and medium.

H. Comply with ANSI Standard B31.1.

END OF SECTION 23 0060

SECTION 230075

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following mechanical identification applications:

1. Equipment identification.

2. Pipe identification.

3. Valve tags.

4. Valve schedule.

5. Duct identification.

1.02 SUBMITTALS

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

B. Product Schedule: Provide schedule indicating each type of identification material to be used for equipment, piping, and ductwork. Indicate colors to be used.

C. Valve and Steam Trap Schedule: Submit a valve and steam trap schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Provide three (3) copies. Mark valves which are intended for emergency shut-off, normally open, normally closed, and similar special uses by special flag in the margin of the schedule. Include the following for each valve:

1. Valve identification number.

2. System.

3. Purpose.

4. Location.

5. Type.

6. Size.

7. Manufacturer.

1.03 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems", for letter size, length of color field, for colors not included in the schedule herein, and for viewing angles of identification devices for piping.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION

A. Engraved Plastic Laminate Identification Signs

1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where using adhesive mounting.

2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.

3. Fasteners: Self tapping stainless steel screws except use contact-type, permanent adhesive where screws cannot or should not penetrate the substrate. Where sign cannot be attached directly to device or equipment, attach with brass chain.

4. Letter sizes: Minimum ¼ inch for names of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

2.02 DUCT IDENTIFICATION

A. Engraved Plastic Laminate Identification Signs

1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, colored black background with white letters except as otherwise indicated.

2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.

3. Fasteners: Contact-type, permanent adhesive.

4. Letter sizes: Minimum ¼ inch for names of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

B. Stencils: As specified and indicated herein.

2.03 STENCILS:

A. Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4" for ducts; and minimum letter height of ¾" for equipment and access door signs.

B. Use alkyd paint.

C. Use stencils only as directed herein.

PART 3 - EXECUTION

3.01 EQUIPMENT IDENTIFICATION

A. Provide permanent, factory, operational data, nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Where manufacturer's nameplate is not stamped or engraved, provide additional heavy gauge, aluminum or brass, stamped or engraved nameplate. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.

B. In addition to factory nameplate, provide an engraved plastic laminate (stenciled) identification sign for each major item of mechanical equipment and each operational device. Provide identification signs for the following general categories of equipment.

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets or steam relief valves.

2. Chillers, cooling towers, condensing units, compressors, pumps, and similar motor-driven units.

3. Heat exchangers, coils, and similar equipment.

4. Fans and blowers.

5. Packaged and central-station type air units.

6. Tanks and pressure vessels.

7. Strainers, filters, humidifiers, water treatment systems, and similar equipment.

8. 8. Control panels.

9. Fuel burning units, such as boilers, furnaces, and heaters.

10. Fire department hose valves and hose stations.

C. Provide engraved sign at each access door, indicating equipment or device to be accessed.

D. Coordinate names, abbreviations, and other designations used in equipment identification with corresponding designations shown, specified, scheduled, or as designated by the Owner's representative. Provide numbers, lettering, and wording as indicated or as directed by the Owner's representative. Owner shall set priority for lettering and graphics. Where multiple systems of the same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, AHU-1H, Standpipe G14).

3.02 PIPE IDENTIFICATION

A. Provide 1” thick molded fiberglass insulation with jacket under each plastic pipe marker to be installed on uninsulated pipes where fluid temperatures will be 125°F or greater. Insulation shall extend 4” beyond edges of marker.

B. Valve tags and steam traps shall be numbered as indicated on the valve listing provided to the Owner.

C. As a minimum, identification shall be applied to piping at the following locations:

1. Adjacent to each valve.

2. At each branch and riser take-off.

3. At each pipe passage through wall, floor, and ceiling construction.

4. At each pipe passage to underground.

5. At not more than forty feet spacing on straight pipe runs.

D. Place identification so it can be easily read. Arrows shall be applied to indicate direction of flow.

E. Underground Piping: During back-filling of each exterior underground piping system, install plastic line marker, located directly over buried line no deeper than 8” below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16”, install a single line marker.

3.03 DUCTWORK IDENTIFICATION

A. Identify ductwork with plastic identification signs. Letter color shall be white. Sign background color shall be according to the following color codes. Indicate direction flow and duct service (such as supply, return, and exhaust).

1. Green: Supply air ductwork.

2. Yellow: Return air ductwork.

3. Blue: Exhaust, outside air, mixed air, and relief air.

B. Apply ductwork identification at the following locations:

1. Adjacent to each damper.

2. At each passage through walls, floors, or ceiling construction.

3. At no more than forty feet intervals.

4. At air handling units, fans, and air terminal boxes

END OF SECTION

SECTION 23 0086

PIPING INSULATION

PART 1 - GENERAL

1.01. SUMMARY

A. Perform all Work required to provide and install piping insulation, jackets, and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.

B. Insulation of Underground Piping is specified elsewhere and not work of this Section.

1.02. REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.

3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.

4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.

5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

9. ASTM C547 - Mineral Fiber Pipe Insulation.

10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

14. ASTM C450 - Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.

15. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.

16. ASTM C921 - Jackets for Thermal Insulation.

17. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

19. ASTM D1667 - Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell).

20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

21. ASTM C795 - Insulation For Use Over Austenitic Steel.

22. ASTM E84 - Surface Burning Characteristics of Building Materials.

23. ASTM E96 - Water Vapor Transmission of Materials.

24. NFPA 255 - Surface Burning Characteristics of Building Materials.

25. UL 723 - Surface Burning Characteristics of Building Materials.

26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.03. DEFINITIONS

A. Concealed: Areas that cannot be seen by the building occupants.

B. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.

C. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.

D. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

E. Unconditioned Space: Interior space that is not temperature-controlled by cooling and/or heating system. Includes attics, chases, unconditioned living spaces and non-conditioned equipment rooms.

1.04. QUALITY ASSURANCE

A. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, and accessories utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.

1. Certificates to this effect shall be submitted along with submittal data.

2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

C. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years' experience specializing in the trade.

D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.

F. Stainless Steel: Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36. These requirements are for prevention of external stress Corrosion Cracking (ESCC) for austenitic stainless steel.

1.05. SUBMITTALS

A. Prepare a schedule of piping insulation showing systems insulated. For each system, show insulation type, thickness, temperature rating, and special conditions where applicable.

B. Submit product data for each piping system. Product data shall include but not be limited to the following:

1. Manufacturer's name

2. Insulation material and thickness

3. Jacket

4. Adhesives

5. Fastening methods

6. Fitting materials

7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings

8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)

9. Other appropriate data

C. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.

D. Operation and Maintenance Data: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.06. DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 - PRODUCTS

2.01. GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02. MANUFACTURERS

A. Insulation:

1. Owens-Corning

2. Certainteed Corporation

3. Johns Manville Corporation

4. Knauf Corporation

5. Armstrong/Armacell (Armaflex)

6. RBX Industries/Rubatex

7. FOAMGLAS (Cellular Glass) by Pittsburgh Corning

B. Jackets:

1. Childers Products Company

2. PABCO

3. RPR Products, Inc.

4. John Mansfield Speedline

5. Foamglas

C. Coatings, Sealants, and Adhesives:

1. Foster

2. Childers

2.03. INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Piping Insulation Type P1: Glass-Fiber, Preformed Pipe Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory applied ASJ-SSL vapor barrier jacket with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Provide one of the following:

1. Owens Corning; Evolution Fiberglas Pipe Insulation.

2. Johns Manville; Micro-Lok Pipe Insulation.

3. Knauf; Earthwool 1000 degree Pipe Insulation.

F. Piping Insulation Type P2: Flexible Elastomeric Pipe Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Provide one of the following:

1. Armacell LLC; AP Armaflex

2. Aeroflex USA Inc; Aerocel

3. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Piping Insulation Type P3: Handicap Lavatory and Sink Piping Insulation Kit:

1. Handicap lavatory and sink drain piping, P-trap, cold and hot water assemblies and valves shall be insulated with fully molded insulation kit specifically designed for handicap lavatories and sinks. ADA conforming.

2. Material shall be 3/16" thick molded closed cell vinyl with nylon fasteners, white finish and be self-extinguishing per ASTM D635, with K value of 1.17 BTU/in./hr./sq. ft./deg. F.

H. Piping Insulation Type P4: Preformed Cellular Glass: Comply with ASTM C 585, ASTM C 450. Provide one of the following:

1. Pittsburgh Corning; Foamglas

2.04. FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe. Provide one of the following:

1. Foster Brand, Specialty Construction Brands, Inc; Mast-A-Fab.

2. Vimasco Corporation; Elastafab 894.

2.05. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Piping Jacket Type J1: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 40 mil thickness, roll stock ready for shop or field cutting and forming. Provide factory-fabricated fitting covers to match jacket. Provide one of the following

1. Johns Manville; Zeston.

2. Proto Corporation; LoSmoke

C. Piping Jacket Type J2: Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14. Provide factory-fabricated fitting covers or field fabricate covers only if factory-fabricated fitting covers are not available. Provide one of the following:

1. Provide Childers Brand Metal Jacketing Systems.

2. Provide shop fabricated smooth aluminum jacket 0.016".

2.06. TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.

2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.

2. Thickness: 6 mils.

3. Adhesion: 64 ounces force/inch in width.

4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf/inch in width.

2.07. INSULATION INSERTS

A. Provide insert between support shield and piping on piping 1 1/2" diameter or larger. Inserts shall be factory fabricated of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

1. 1 1/2" to 2 1/2" pipe size 10" long

2. 3" to 6" pipe size 12" long

3. 8" to 10" pipe size 16" long

4. 12" and over 22" long

2.08. PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12-inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

F. Adhesives: Compatible with insulation.

G. Banding:

1. Aluminum bands, 3/4" x 0.02 inches

2. Stainless Steel, 304, 3/4" by 0.02 inches

PART 3 - EXECUTION

3.01. PREPARATION

A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application. Insulating piping where condensate is occurring is unacceptable. Wet insulation is unacceptable and shall be removed and replaced before acceptance by the Owner.

B. Coordinate insulation installation with trade installing heat trace. Comply with requirements for heat tracing that apply to insulation.

C. Verify that piping has been tested for leakage before applying insulation.

3.02. GENERAL INSTALLATION REQUIREMENTS

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards, and shall conform to codes and ordinances of authorities having jurisdiction.

B. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.

C. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.

D. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.

E. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.

F. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

G. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

H. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

I. Install insulation with longitudinal seams at top and bottom of horizontal runs.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Keep insulation materials dry during application and finishing.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

P. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.

T. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.03. PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Section 15050 for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 15050."

3.04. GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket where concealed unions, check valve or piping specialties are insulated. Provide descriptive label at device under the insulation. For example, at each union stencil with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06. INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on below-ambient surfaces, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.07. FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.08. FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Do not field paint aluminum jackets.

3.09. PIPING SYSTEMS INSULATION SCHEDULE

PIPING SYSTEMS INSULATION SCHEDULE					
Service	Insulation Type	Location	Jacket Type	Pipe Size	Insulation Thickness by Pipe Size
COLD PIPING					
Chilled Water	P1	Interior Concealed	--	3.0" and smaller	1.0"
				4.0" and larger	1.5"
Cooling Tower Condenser Water	P1	Interior Exposed	J1	3.0" and smaller	1.0"
		Exposed		4.0" and larger	1.5"
		Unconditioned Space	--	3.0" and smaller	1.0"
				4.0" and larger	1.5"
		Unconditioned Space	--	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms	J1	3.0" and smaller	1.5"
		below 7.0ft above floor		4.0" and larger	2.0"
Make-Up Water		Interior	J1	0.5" and smaller	0.5"

		Exposed		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned Space	--	0.5" and smaller	0.5"
				1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned Space	--	0.5" and smaller	0.5"
				1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Exterior	J2	0.5" and smaller	1.0"
				1.0" through 2.0"	1.5"
				2.5" and larger	2.0"
		Equipment Rooms below 7.0ft above floor	J1	0.5" and smaller	0.5"
				1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
Refrigerant Suction	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed	J1	3.0" and smaller	0.75"
				4.0" and larger	1.0"

		Unconditioned Space	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Equipment Rooms: below 7.0ft above floor	J1	3.0" and smaller	0.75"
				4.0" and larger	1.0"
Cooling Coil Condensate Drain Branch Lines	P2	Interior Concealed	--	3.0" and smaller	0.5"
				4.0" and larger	0.75"
Cooling Coil Condensate Drain Main Lines		Interior Exposed	J1	3.0" and smaller	0.5"
				4.0" and larger	0.75"
Sewer/Storm Drain Lines Carrying Cooling Coil Condensate		Unconditioned Space	--	3.0" and smaller	0.5"
				4.0" and larger	0.75"
		Exterior	J2	3.0" and smaller	0.5"
HOT PIPING					
Heating Water	P1	Interior Concealed	--	3.0" and smaller	1.0"
				4.0" and larger	1.5"
		Interior Exposed	J1	3.0" and smaller	1.5"
				4.0" and larger	2.0"

		Unconditioned Space	--	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms below 7.0ft above floor	J1	3.0" and smaller	1.5"
				4.0" and larger	2.0"
Refrigerant Hot Gas	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed		3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Unconditioned Space	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Equipment Rooms below 7.0ft above floor		3.0" and smaller	0.75"
				4.0" and larger	1.0"

END OF SECTION 230086

SECTION 23 0090

SUPPORTS, HANGERS AND ANCHORS

PART 1 GENERAL

1.01. WORK INCLUDED

A. Inserts, Anchors, and Upper Attachments

B. Pipe Hangers, Rods, Supports, and Accessories

C. Fabricated Steel Support

1.02. QUALITY ASSURANCE

A. Design of pipe supporting elements shall be in accordance with ANSI B31.1

B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards:

1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.

2. SP-69 Pipe Hangers and Supports: Selection and Application.

3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.

C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications and hot galvanized for exterior applications.

D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.

E. Welding of steel members shall be in accordance with AWS D1.1.

F. Steel supports for ducts, pipe anchors, pipe guides, and piping supported from below shall be fabricated in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. If required, the Contractor shall include the cost of the services of a structural engineer to design or review the system.

1.03. APPLICABLE PUBLICATIONS

A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced by the basic designation only.

1. American Institute of Steel Construction (AISC)

2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)

4. American Welding Society (AWS)

5. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

6. National Fire Protection Agency (NFPA)

7. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

1.04. SUBMITTALS

A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.

B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

C. Provide shop drawings for fabricated steel supports.

PART 2 PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS

A. Inserts, Anchors, and Upper Attachments:

1. Anvil International, Inc.
2. Carpenter Paterson, Inc.
3. Cooper B-Line, Inc.
4. Elcen Metal Products
5. Hilti
6. Unistrut
7. ITW Red Head

B. Pipe Hangers, Rods, Supports and Accessories:

1. Anvil International, Inc.
2. Carpenter Paterson, Inc.
3. Cooper B-Line, Inc.
4. Elcen Metal Products
5. Hilti
6. Unistrut

C. Fabricated Steel Support: As indicated on Drawings.

2.02. DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions. Provide 4-to-1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction, and installation of pipe hangers, supports, guides, restraints, and anchors:

1. ASME B31.3.

2. MSS SP-58 and MSS SP-69.

3. Except where modified by this Specification.

E. For steam and hot and cold-water piping, design, materials of construction and installation pipe hangers, supports, guides, restraints and anchors:

1. ASME B31.1

2. MSS SP-58 and MSS SP-69.

F. Check all physical clearances between piping, support system, and structure. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.

H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.

I. Fabricated Steel Supports: As detailed on the drawings.

2.03. INSERTS AND ANCHORS

A. Inserts: MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable.

B. Anchors: Steel shell and expander plug, snap off end fastener

2.04. HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Select size of hangers and supports to exactly fit pipe size for bare piping, and around piping insulation with saddle or shield for insulated piping.

B. For suspension of non-insulated or insulated stationary pipe lines: Adjustable steel clevices, MSS Type I.

C. For suspension of non-insulated stationary pipe lines: Adjustable band hangers, MSS Type 7 or 9; or split pipe rings, MSS Type II.

D. For support of piping where horizontal movement due to expansion and contraction may occur, and where a low coefficient of friction is desired: Pipe slides and slide plates, MSS Type 35, including guided plate mounted on a concrete pedestal or structural steel support.

E. For support from floor stanchion, using floor flange to secure stanchion to floor: Adjustable pipe stanchion saddles, MSS Type 37 or 38, including steel pipe base support and cast-iron floor flange.

F. For suspension of pipe from two (2) rods where longitudinal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.

G. For suspension of pipe from a single rod where horizontal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.

H. For support of pipe from a single rod where vertical adjustment is not necessary: Pipe roll stands, MSS Type 45.

I. For support of pipe where small horizontal movement due to expansion and contraction may occur, but vertical adjustment is not necessary: Pipe rolls and plates, MSS Type 45.

J. For support of pipe lines where vertical and lateral adjustment during installation may be required in addition to provision for expansion and contraction: Adjustment pipe rolls stands, MSS Type 46.

2.05. VERTICAL PIPING CLAMPS

A. Select size of vertical piping clamps to exactly fit size of bare pipe.

B. For support and steadying of pipe risers: Two-bolt riser clamps, MSS Type 8 or 42.

2.06. HANGER ROD ATTACHMENTS

A. Select size of hanger rod attachments to suit hanger rods.

B. For adjustment up to six (6) inches for heavy loads: Steel turnbuckles, MSS Type 13.

C. For use on high temperature piping installations: Steel clevices, MSS Type 14.

D. For use with split pipe rings, MSS Type II: Swivel turnbuckles, MSS Type15.

E. For attaching hanger rod to various types of building attachments: Malleable iron sockets, MSS Type 16 or 17.

F. Rods:

1. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

Copper Tube, Plastic	Steel, Cast Iron		
Pipe Size (Copper, Plastic)	Pipe Size (Steel, Cast Iron)	Rod Size	Max. Equip. Load
1/4" to 2"	1/4" to 2"	3/8"	730 lbs.
2-1/2" to 4"	2-1/2" to 3"	1/2"	1,350 lbs.
6"	4"	5/8"	2,160 lbs.
8" to 12"	6"	3/4"	3,230 lbs.
14"	8" to 12"	7/8"	4,480 lbs.
16"	14" to 16"	1"	5,900 lbs.
18" to 20"	18" to 20"	1-1/4"	9,500 lbs.
22" to 42"	22" to 42"	1-1/2"	13,800 lbs.

2. Rods may be reduced one size for double rod hangers with 3/8" minimum diameter, or when other paragraphs require a minimum of 2 hangers per section, provided the minimum diameter of 3/8" is maintained.

G. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18.

H. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19.

I. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 20 or 27.

J. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21.

K. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22.

L. For attachment to structural shapes: C-clamps, MSS Type 23.

M. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beams clamps, MSS Type 25.

N. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut, MSS Type 28 or 29.

O. Steel brackets, for indicated loading:

1. Light duty, 750 pounds, MSS Type 31.

2. Medium duty, 1,500 pounds, MSS Type 32.

3. Heavy duty, 3,000 pounds, MSS Type 33.

P. For use on sides of steel beams: Side beam brackets, MSS Type 34.

2.07. SPRING HANGERS AND SUPPORTS

A. Select spring hangers and supports to suit pipe size and loading.

B. For control of piping movement: Restraint control devices, MSS Type 47.

C. For light loads where vertical movement does not exceed 1-1/4 inch: Springs cushion hangers, MSS Type 48.

D. For equipping Type 41 roll hanger with springs: Spring cushion roll hangers, MSS Type 49.

E. For retardation of sway or thermal expansion in piping systems: Spring way braces, MSS Type 50.

F. For absorbing expansion and contraction of piping system from hanger: Variable spring hangers, MSS Type 51; preset to indicated load and limit variability factor to 25%.

G. For absorbing expansion and contraction of piping system from base support: Variable spring base supports, MSS Type 52; preset to indicated load and limit variability factor to 25%; include flange.

H. For absorbing expansion and contraction of piping system from trapeze support: Variable spring trapeze hangers, MSS Type 53; preset to indicated load and limit variability factor to 25%.

I. Constant supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.

1. Horizontal Type: MSS Type 54.

2. Vertical Type: MSS Type 55.

3. Trapeze Type: MSS Type 56.

2.08. SUPPLEMENTARY SUPPORTS

A. Where support spacing is more frequent than distance between structural members, provide steel angles, channels or beams sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.

B. Where deflection of center of trapeze support exceeds 1/240 of distance between hanger rods, provide additional hanger rods.

C. Where multiple risers are supported within shafts, provide steel angles, channels or beams, sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.

2.09. ACCESSORIES

A. Protective Shields, MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation.

B. Protective Saddles, MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation.

C. Steel Turnbuckle, MSS Type 13: Forges steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size.

D. Steel Clevis, MSS Type 14: Forged steel, galvanized finish with steel pin and cotter pin. Rated for a minimum of 730 lbs. at 3/8" size.

E. Weldless Eye Nut, MSS Type 17: Forges steel, galvanized finish. Rated for a minimum of 730 lbs. at 3/8" size.

2.10. PIPE INSULATION HANGER SHIELDS

A. Where hangers are placed outside the jackets of pipe insulation, provide shields equal to "Thermal Hanger Shields" as manufactured by Pipe Shields, Inc. or equivalent by Elcen Metal Products Company.

B. Shields shall consist of a 360-degree insert of high-density, 100 psi, waterproof calcium silicate, encased in a 360-degree galvanized sheet steel shield. Insert shall be same thickness as adjoining pipe insulation, and shall extend 1 inch beyond sheet metal shield in each direction on cold lines. Shield lengths and minimum sheet metal gauges shall be as directed below:

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2" to 1-1/2"	4"	26
2" to 6"	6"	20
8" to 10"	9"	16
12" to 18"	12"	16
20" & Larger	18"	16

C. Shields shall be Model CS-CW, except for pipe roller applications: then provide Model CSX-CW.

D. At the Contractor's option, shop-fabricated galvanized metal shields may be provided based on approved shop drawings. Length and gauge of sheet metal shall be as specified above.

E. For all insulated piping 4” and larger, provide insulation insert at a minimum of 12” long. Insert shall extend a minimum of one inch beyond shield. Insulation inserts shall be minimum 12” long section of foam glass insulation.

2.11. METAL FRAMING: Provide products compliant with NEMA ML-1.

2.12. STEEL PLATES, SHAPES AND BARS: Provide products compliant with ANSI/ASTM A-36.

2.13. PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base, with a two-section guiding spider bolted tight to pipe or as shown on Drawings. Size guides and spiders to clear pipe, cylinder and insulation, if any. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

A. Where applicable, install in accordance with the manufacturer's written installation instructions.

B. Where supports are in contact with copper pipe, provide copper plated support.

C. Where supports are in contact with glass, aluminum or brass pipe, provide plastic coating on supports.

D. Interior hangers, supports, including attachments, that are plain steel shall be primed and painted.

E. Hangers and supports, including attachments, exposed to weather or located in utility tunnels or accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication.

F. Fabricated steel supports exposed to weather or located in utility tunnels and accessible utility trenches or subject to spillage shall be primed and painted. Cut, welded, drilled or otherwise damaged surfaces of coating shall be repaired.

3.02. PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including but not limited to proper placement of inserts, anchors and other building structural attachments.

3.03. INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure in compliance with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together in trapeze-type hangers where possible. Install supports with maximum spacing as specified in this Section. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for small diameter pipe. Do no use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and

supports of same type and style as installed for adjacent similar piping.

C. Support fire protection water piping independently of other piping

D. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.

E. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate und upper attachment. Rod nuts shall be securely locked in place.

F. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.

G. Hangers shall be fabricated to permit adequate adjustment after erection while still supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.

H. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.

I. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.

J. Provide protective shields on all piping required to be insulated.

K. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.

L. Provide turnbuckles on all hangers that require leveling or aligning.

M. Provide steel clevis where detailed and/or required.

N. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.

O. Supports

1. Provide additional supports at:

    a. Changes in direction.

    b. Branch piping and runouts over 5 feet.

    c. Concentrated loads due to valves, strainers and similar items.

    d. At valves 4 inches and larger in horizontal piping.

    e. Support piping on each side of valve.

    f. Brace hubless piping to prevent horizontal and vertical movement.

    g. Where number of grooved couplings exceeds 3 between supports or provide continuous steel between supports.

2. Sanitary waste and vent, roof drains per UPC Section 316: Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.

3. Other piping support spacing shall be as scheduled on Drawing or as required by referenced standard.

3.04. HANGER SPACING

A. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturer's written installation instruction, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING TABLE

1. Steel Pipe (Schedule 40 & 80):
   Up to 1"..... 7 ft. on center
   1-1/4" and greater..... 10 ft. on center

2. Copper Pipe (Types L, K and M):
   Up to 1" size:..... 5 ft. on center
   1-1/4" to 2-1/2" ..... 7 ft. on center
   3" and larger..... 10 ft. on center

3. Ductile Iron and Cast Iron: Two hangers per section length.

4. Polyvinyl Chloride (PVC):
   Up to 1-1/2" ..... 3 ft. on center
   2" to 4" ..... 4 ft. on center
   5" to 8" ..... 5 ft. on center
   10" and larger..... 6 ft. on center

5. Sprinkler and Standpipe: Pipe hangers to be as per NFPA-13 and NFPA-14 standards.

B. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.

3.05. ATTACHMENT TO STRUCTURE

A. For plain steel devices, prime and paint.

B. Adjust attachment location for proper alignment and no more than 4 degrees offset from a perpendicular alignment.

C. If proper alignment cannot be achieved from the existing building structure, provide a trapeze type support sized to handle the design load with a minimum safety factor of 5.

3.06. INSERTS

A. Contractor shall have inserts at site and dimensional location drawings ready at the beginning of the involved concrete work.

B. Install inserts by securing to concrete forms and inserting reinforcing rod through the opening provided in the insert in accordance with shop drawings.

C. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.

3.07. INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B-31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bards to piping and to structure. Comply with ANSI B-31, with AWS standards, and with the Details shown on the drawings.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required, accommodating both expansion and contraction of piping.

E. Size anchor shell length to assure a minimum of 1" solid concrete remaining from shell and to concrete face.

3.08. INSTALLATION OF TRAPEZES OR PIPE RACKS

A. Light/Medium Duty: Assemble from standard manufactured metal framing systems, in accordance with manufacturer's recommendations.

B. Heavy Duty: Fabricate from structural steel shapes selected for loads required. Weld steel in accordance with AWS standards.

3.09. AUXILIARY STEEL

A. Furnish all miscellaneous structural members necessary to hang or support ductwork, piping, and mechanical equipment.

B. Notify Engineer of any adjustment necessary in main structural system for proper support of major equipment.

C. Fabricated Steel Supports: Steel for supports shall be saw cut, with sharp edges ground smooth. After fabrication, remove all foreign material, including welding slag and spatter, and leave ready for painting.

END OF SECTION

SECTION 23100
VIBRATION ISOLATION AND SEISMIC RESTRAINT FOR MECHANICAL COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.

Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

1.2 DESCRIPTION

This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II, III, & IV structures, including, but not limited to:

1. Mechanical Components: heating, ventilating, and air-conditioning systems; hot/chilled water systems; boiler equipment and components; tanks and vessels, etc.

Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

1.3 DEFINITIONS

Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.

Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.

Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.

Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.

Component Importance Factor (I_p): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.

Consequential Damage: Failure of an essential component caused by the failure of a separate essential or non-essential component due to the functional and physical interrelationship of the components, their supports, and their effect on each other.

Designated Seismic System: Those nonstructural components that require design in accordance with Chapter 13 of ASCE 7, for which the Component Importance Factor (Ip) is 1.5 in accordance with Section 13.1.3 of ASCE 7.

Special Seismic Certification: A certificate of compliance, supplied by the manufacturer of Active Designated Seismic Systems, which certifies that the equipment will remain operable during the design seismic event. Components with hazardous contents shall be certified as maintaining containment following the design seismic event.

Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.

Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

1.4 REGULATORY REQUIREMENTS

Comply with the 2021 International Building Code (IBC) and applicable local adopted amendments, and the 2016 Edition on ASCE 7 (ASCE 7-16).

1.5 DESIGN PERFORMANCE CRITERIA

Provide seismic restraint of components to withstand seismic forces and displacements without displacing or overturning. Design of seismic restraint shall be performed in accordance with the 2021 International Building Code and ASCE 7, as follows.

1. Seismic forces shall be determined in accordance with Chapter 13 of ASCE 7. The seismic design parameters shall be as noted in the project Structural drawing. The assigned Component Importance Factors (Ip) for each component, shall be as noted on the project drawings and/or specifications.

2. For components installed on the exterior of the building, wind forces shall be determined in accordance with Chapter 29 of ASCE 7-16, except that the uplift forces per Equation 29.5-3 shall be considered regardless of the building height. Reference the Structural drawings for wind design criteria.

3. In addition to seismic and wind loads, consideration shall be given to other loads, including but not limited to dead, live, snow, etc., as applicable. All restraint design shall be based on the "worst case" combination of the applicable loads as prescribed by the referenced code and standards.

4. Consideration shall also be given to thermal stresses and expansion. Where thermal expansion applies, seismic restraint design shall be in accordance with the requirements of ASME B31.1 in addition to ASCE 7.

1.6 SUBMITTALS

Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.

Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation and seismic restraint.

Vibration Isolation: submit the following, at a minimum, as applicable.

1. Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.

2. Detailed drawings showing equipment, isolator bases and isolator spacing.

3. Descriptive data or cut sheets for each type of isolation mounting, including:

    a. Dimensional data

    b. Materials and finish

    c. Rated loads

    d. Rated deflection

    e. Isolator free and operating heights

    f. Detailed installations instructions

Seismic Restraint: submit the following, at a minimum, as applicable.

4. Catalog cut or data sheets on specific restraints detailing compliance with the project drawings and specifications.

5. Detailed schedules of components, showing seismic restraints by referencing numbered descriptive drawings.

6. Description, layout and location of items to be restrained with anchorage or brace points noted and dimensioned.

7. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, fasteners, bolts, welds etc. clearly identified and specified.

8. Numerical value of design seismic restraint loads, or controlling loads if different than load combinations with seismic, with all supporting calculations.

9. Detailed installation instructions for seismic restraints.

10. Acceptable attachment methods of seismic restraints to structural members.

11. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.

12. Details for housekeeping pads for base-mounted equipment, including reinforcing and doweling requirements to the building structure.

13. Documentation verifying seismic prequalification for anchors in concrete per ACI 318 Appendix D.

14. Additional information as required to substantiate adequate design and installation of seismic restraints.

15. Manufacturer's Seismic Certificate of Compliance: Each manufacturer of a Designated Seismic System (with a Component Importance Factor, Ip = 1.5) shall submit a ***Certificate of Compliance*** for review and acceptance by the design professional in responsible charge and the authority having jurisdiction, prior to installation.

PART 2 - PRODUCTS

2.1 GENERAL

All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

Refer to the "Selection Guide" table in Section 4 to correlate the specification references listed below with the appropriate components.

2.2 MANUFACTURERS

Isolators and seismic restraints shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators and seismic restraint systems listed in the following sections are as manufactured by Gripple and California Dynamics.

1. Gripple
2. California Dynamics
3. The VMC Group
4. Mason Industries
5. Kinetics Noise Control
6. Cooper B-Line
7. CADDY
8. Hilti
9. Twin City Hose

10. Imperial Metals

2.3 EQUIPMENT BASES

Specification B-1 (Integral Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-2 (Wide Flange Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-3 (Concrete Inertia Base): Rectangular steel concrete pouring forms for floating concrete frames. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 12" centers running both ways in a layer 1 1/2" above the bottom. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Base shall be type CW as manufactured by California Dynamics Corporation or approved equal

Specification B-4 (Non-Isolated Curbs): Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchored to concrete deck, or bolted or welded directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. **Curb shall use minimum 18 gage galvanized steel and shall be designed with cross bracing required to withstand the greater of calculated seismic forces and /or wind loading per local building code**. Design must be certified by registered professional engineer.

Specification B-5 (Isolated Curbs): Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. The upper curb shall be supported by Spec SV-1 isolators welded or bolted to concrete deck to the structure to withstand seismic loading. An EPDM nylon reinforced air tight weatherproof seal shall consolidate the upper and lower curbs. The lower curb shall be weatherproof and provide a base that the roofing system may be flashed to. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings**. Isolation curb shall be designed to withstand the greater of calculated seismic forces and / or wind loading per local building code**. Design must be certified by registered professional engineer.

Specification B-6 (Non-Isolated Rails): Non isolated seismically rated rooftop rail system that provides equipment support in one roof flashed assembly with all features as described for Non-Isolated Curbs.

Specification B-7 (Isolated Rails): Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment. Structural steel rails shall be type, WW as manufactured by California Dynamics Corporation or approved equal.

2.4 VIBRATION ISOLATION

Specification V-1 (Pad Type Elastomer Isolator): A pad type mounting consisting of two layers of ribbed elastomeric pads with a 1" sandwich pad in between. Where the equipment foot is less than 80 percent of the surface of the pad a load distribution plate must be added to the top of the pad. Pads shall be VT as manufactured by California Dynamics Corporation or approved equal.

Specification V-2 (Neoprene Mounting): Elastomeric mounts single or double-deflection type, oil-resistant rubber or Neoprene isolator element with factory-drilled, bonded in place top plate for bolting to equipment and factory drilled base plate for bolting to structure. Color-coded or otherwise identify to indicate capacity range. Mount shall be type RM/RMD as manufactured by California Dynamics Corporation or approved equal.

Specification V-3 (Spring Isolator, Free Standing): Spring isolators shall be free standing and laterally stable without any housing and complete with a Neoprene acoustical pad between the base plate and the spring support. All mountings shall have load transfer bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mountings shall be type SSL/K, as manufactured by California Dynamics Corporation or approved equal.

Specification V-4 (Elastomer Hanger Isolator): Hanger shall consist of a rigid steel frame and up to ½" deflection of a molded Neoprene element projecting thru the steel box so that no metal-to-metal contact occurs. Hanger shall be type RH/RHD as manufactured by California Dynamics Corporation or approved equal.

Specification V-5 (Spring Hanger Isolator): Hanger shall consist of a rigid steel frame containing a steel spring with a Neoprene sleeve to prevent steel to steel contact. Hanger shall be type CH as manufactured by California Dynamics Corporation or approved equal

Specification V-6 (Combination Spring/Elastomer Hanger Isolator): Hangers shall consist of rigid steel frames containing double deflection Neoprene element at the top and a steel spring and a Neoprene sleeve on bottom to position spring and prevent steel to steel contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc from side to side. Hangers shall be type HH30 as manufactured by California Dynamics Corporation or approved equal.

2.5 VIBRATION ISOLATION WITH SEISMIC RESTRAINT

Specification SV-1 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A steel housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. The housing shall be Zinc plated. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be CQA as manufactured by California Dynamics Corporation or approved equal. This product is an OSHPD/ DSA approved product. Product tested for IBS.

Specification SV-2 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A welded housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be DLK as manufactured by California Dynamics Corporation or approved equal.

Specification SV-3 (Neoprene Mounting with Seismic Snubber) JQTQN Restrained Neoprene isolators shall be free standing, with a rated static defection of .5". A steel housing with cushioned lateral and vertical limit stops to restrict extension due to wind loads, or when weight is removed. The housing shall be hot-dipped galvanized or zinc plated. Hot-Dipped zinc coating shall be not less than 2 ounces per square foot complying with ASTM A123. A clearance of ¼ "maximum shall be maintained around restraining bolts and between the housing and the Neoprene so as not to interfere with the isolator action. Limit stops shall be out of contact during normal operation. Isolator/Restraint shall be JQTQN as manufactured by California Dynamics Corporation.

2.6 SEISMIC RESTRAINTS

Specification S-1 (Seismic Snubbers): All directional seismic restraints shall consist of interlocking steel members. Neoprene shall have a minimum thickness of ¼". Incorporate a minimum air gap of 1/8", and a maximum air gap of ¼" in the design, before contact is made between the rigid and resilient surfaces. Provide removable end plate to allow inspection of internal clearances. Restraints shall be type RL-A/ RL-C as manufactured by California Dynamics Corporation.

Specification S-2 (Seismic Cable Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable Restraints shall be listed with any one of following evaluation agencies with certified break strength and shall be color-coded or include a tag for easy field verification.

1. IAPMO-UES

2. ICC-ES

3. OSHPD

4. Underwriters Laboratories (UL)

Secure cable to structure and braced component through bracket or stake eye specifically designed to meet or exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASTM A1023 or EN-12385 or other approved equivalent. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Gripple Inc. GS series.

Specification S-3 (Rigid Brace Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of steel angles or channels. Rigid braces and connecting elements shall be sized for the applied seismic loads. Connecting elements shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment. Restraint shall be CADDY Strut Seismic Hinge.

2.7 FLEXIBLE PIPE CONNECTIONS

Specification F-1 (Water Service Flexible Connection):

1. For flanged connections – A double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77" compression, 1.18" lateral and 1.18" extension. Connectors shall provide a minimum 35 degree angular movement up to 6", minimum 30 degree up to 12" and minimum 20 degree up to 24". Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Twin City Hose Type MS2.

2. For threaded type – A double spherical rubber hose connector, minimum 8" long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8" compression, 7/8" lateral, ¼" extension and 20 degrees angular through 1-1/4", 13 degrees through 2", and 9 degrees through 3". Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225-degree F. Connectors shall have cable control units to limit extension to ¼". Flex connector shall be Twin City Hose Type MSFU.

Specification F-2 (Steam and Condensate Service):

3. For flanged connection – A metal hose connector constructed of stainless-steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Twin City Hose Type TCHS-FLG.

4. For threaded connections – A metal hose connector constructed of stainless-steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Twin City Hose Type TCHS-MMT.

PART 3 - EXECUTION

3.1 EXAMINATION

All areas that will receive components requiring vibration isolation and seismic restraint shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

3.2 INSTALLATION, GENERAL

Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.

Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

3.3 SEISMIC RELATIVE DISPLACEMENTS

Provide joints with sufficient flexibility capable of accommodating seismic relative displacements as follows.

1. Vertical ductwork, piping, etc. that pass between floors of the building,

2. Components that pass through a building seismic or expansion joint,

3. Rigidly supported components that connect to other components.

3.4 POST-INSTALLED ANCHORS:

Install all anchors in accordance with the manufacturer's written instructions for seismic applications.

Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

3.5 HOUSEKEEPING PADS

Housekeeping pads shall be designed by the seismic restraint vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated seismic or wind forces. Frictional resistance due to the effects of gravity shall be neglected.

The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.

1. If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

2. If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

3.6 MECHANICAL COMPONENTS

Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.

1. Design equipment anchorage to resist seismic design force in any direction.

2. Design vibration and seismic controls for equipment to include base and isolator requirements.

3. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.

4. Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.

5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.

6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.

7. Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.

Suspended mechanical equipment

8. Design support and bracing to resist seismic design force in any direction.

9. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.

10. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.

Wall-mounted mechanical equipment

11. Design attachments to resist seismic design force in any direction.

12. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

Piping

13. Provide supports, braces and anchors to resist gravity and seismic design forces.

14. Design piping and piping risers to accommodate interstory drift. Provide flexible connections wherever relative differential movements could damage pipe in an earthquake.

15. Brace every run (5’ or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center.

16. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.

17. Where piping is explicitly exempt from seismic bracing requirements,

    a. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components. This will be considered satisfied if there is horizontal clear distance of at least 2/3 the hanger length between subject components.

    b. Provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.

Ductwork

18. Provide supports, braces and anchors to resist gravity and seismic design forces.

19. Design ducts and duct risers to accommodate interstory drift. Provide flexible connections wherever relative differential movement could damage duct in an earthquake

20. Provide independent support and bracing for all in-line devices weighing more than 75 pounds.

3.7 QUALITY CONTROL

Do not install vibration isolators or seismic restraints until submittals have been reviewed and approved by the registered design professional in responsible charge.

Verify that multiple systems installed in the same vicinity can be installed without conflict.

Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.

No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.

Where Special Inspections are required per Sections 1704 and 1705 of the 2015 International Building Code, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE

MECHANICAL EQUIPMENT

EQUIPMENT TAG	**Ip (Note 7)**	**ISOLATION SPEC.**	**ISOLATION DEFL.**	**SEISMIC REST. SPEC. (NOTE 1)**
PACKAGED RTU > 5 TONS	1.0	SPEC B-5	2”	SPEC B-5
PACKAGED RTU ≤ 5 TONS	1.0	N/A	N/A	SPEC B-4
GAS PACKAGED RTU > 5 TONS	1.5	SPEC B-5	2”	SPEC B-5
GAS PACKAGED RTU ≤ 5 TONS	1.5	N/A	N/A	SPEC B-4
SUSPENDED GAS FURNACE	1.5	V-6	1.5”	SPEC S-2
AIR HANDLING UNITS	1.0	INTERNAL	2”	NOTE 2

(FLOOR)		BY MANUF.		
AIR HANDLING UNITS (SUSP)	1.0	SPEC V-6 SPEC F-1	1.5”	SPEC S-2
VAV (NON-FAN) TERM. < 20 LB	1.0	NONE	N/A	NONE
VAV (NON-FAN) TERM. ≥ 20 LB	1.0	NONE	N/A	SPEC S-2
FAN VAV TERMINAL	1.0	SPEC V-4	.5”	SPEC S-2
INLINE FANS	1.0	SPEC V-6	1.5”	SPEC S-2
CEILING FANS ≥ 20 LB	1.0	SPEC V-4	.5”	SPEC S-2
CEILING FANS < 20 LB	1.0	NONE	N/A	NONE
CEILING DIFFUSERS ≥ 20 LB	1.0	NONE	N/A	(2) 12 GA WIRES TO STRUCTURE, NOTE 3
WALL MOUNT FANS	1.0	NONE	N/A	NOTE 2
UTILITY SETS (FLOOR)	1.0	SPEC SV-2	1”	SPEC SV-2
UTILITY SETS (SUSP.)	1.0	SPEC V-6	1.5”	SPEC S-2
ROOF EXHAUST FANS	1.0	NONE	N/A	SPEC B-3
CHILLERS (ON GRADE)	1.0	SPEC V-1 SPEC F-1	.15”	NOTE 2
CHILLERS (ROOF OR UPPER FLOORS)	1.0	SPEC SV-1 SPEC F-1	2.0”	SPEC SV-1
BOILERS (ON GRADE)	1.5	SPEC V-1	.15”	NOTE 2
BOILERS (UPPER FLOORS)	1.5	SPEC SV-1	1”	SPEC SV-1
PUMPS (ON GRADE) < 7.5 HP	1.0	NONE SPEC F-1	.15”	NOTE 2
PUMPS (ON GRADE) ≥ 7.5 HP	1.0	SPEC B-3 & SV-2 SPEC F-1	1”	SPEC SV-2
PUMPS (UPPER FLOORS)	1.0	SPEC B-3 & SV-2 SPEC F-1	2”	SPEC SV-2
INLINE PUMPS < 5 HP	1.0	NONE	N/A	SPEC S-2
INLINE PUMPS ≥ 5 HP	1.0	SPEC V-6	1.5”	SPEC S-2
AIR SEPARATORS & EXP. TANKS	1.0	NONE	N/A	NOTE 2

COOLING TOWERS (ON GRADE)	1.0	SPEC B-2 & V-1	.15”	NOTE 2
COOLING TOWERS (ROOF)	1.0	SPEC B-2 & SV-1	2.0”	SPEC SV-1
GAS PIPING	1.5	NOTE 6	N/A	SPEC S-2
GAS UNIT HEATERS (SUSP)	1.5	NONE	N/A	SPEC S-2
UNIT HEATERS (SUSP)	1.0	NONE	N/A	SPEC S-2
CABINET HEATERS (SUSP)	1.0	SPEC V-4	.5”	SPEC S-2
FAN COILS	1.0	SPEC V-6	1.5”	SPEC S-2
KITCHEN HOODS	1.5	NONE	N/A	SPEC S-2
WATER SOURCE HEAT PUMP (SUSP.)	1.0	SPEC V-6	1.5”	SPEC S-2
WATER SOURCE HEAT PUMP (FLOOR)	1.0	SPEC SV-2	1”	SPEC SV-2
STEAM TO WATER HEAT EXCHANGER	1.5	NONE	N/A	NOTE 2
WATER TO WATER HEAT EXHANGER	1.0	NONE	N/A	NOTE 2
EXPANSION TANK	1.0	NONE	N/A	NOTE 2
AIR SEPARATOR	1.0	NONE	N/A	NOTE 2
FLASH TANK	1.5	NONE	N/A	NOTE 2
CHILLED WATER PIPING	1.0	NOTE 6	N/A	SPEC S-2
HOT WATER PIPING	1.0	NOTE 6	N/A	SPEC S-2
STEAM PIPING	1.5	NOTE 6	N/A	NOTE 4
STEAM CONDENSATE PIPING	1.5	NOTE 6	N/A	NOTE 4
DUCT	1.0	NOTE 6	N/A	SPEC S-2
DUCT USED FOR SMOKE CONTROL	1.5	NOTE 6	N/A	SPEC S-2

NOTES

1. Provide seismic restraint per table or as directed by seismic engineer stamped drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. Diffusers weighing less than 20 lbs must be mechanically attached to ceiling grid, but require no additional restraint.
4. Anchors and guides to be designed to accommodate thermal expansion and seismic loads.

5. Roof curbs provided by others must be certified by a professional engineer for the required seismic loads.
6. Provide Type V-6 isolator for the first three hangers from all equipment specified with spring isolation.
7. All components in a Risk Category IV building are assigned a Component Importance Factor I_p equal to 1.5.

END OF SECTION

SECTION 23 0160

MECHANICAL SYSTEMS INSULATION

PART 1 GENERAL

1.01 Provide required insulation for HVAC ductwork and plumbing piping.

1.02 All ductwork and piping is insulated unless otherwise noted.

1.03 SUBMITTTALS

A. Submit product data for each system. Product data shall include but not be limited to the following:

1. Manufacturer's name

2. Insulation material and thickness

3. Jacket

4. Adhesives

5. Fastening methods

6. Fitting materials

7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings

8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)

9. Other appropriate data

1.04 QUALITY ASSURANCE

A. All ductwork and piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

C. Application Company Qualifications: Company performing the Work of this Section must have a minimum of three (3) years' experience specializing in the trade.

D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

E. All insulation shall be applied in strict accordance with these Specifications and with adequate factory-printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 HVAC PIPING:

A. Condensate Drain (Above Ground): Armstrong's "Armaflex AP" pipe insulation, 1/2" thick.

B. Refrigerant

1. Insulate with “Armaflex AP" pipe insulation, 1/2" thick for the following:

a. All Suction Lines.

b. Mixed Phase lines for ductless split systems.

c. Suction and Liquid lines for dedicated 100% outside air split systems.

2.03 MANUFACTURERS

A. CertainTeed Corporation.

B. Johns Manville Corporation.

C. Knauf Corporation.

D. Owens-Corning.

E. Unifrax 1 LLC (FyreWrap).

F. Armacell

2.04 INSULATION MATERIALS

A. Type D1: Flexible glass fiber; ASTM C553 and ASTM C1290; commercial grade; 'k' value of 0.25 at 75 degrees F; 1.5 lb./cu ft minimum density; 0.002-inch foil scrim kraft facing for air ducts.

B. Type D2: Rigid glass fiber; ASTM C612, Class 1; 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; 0.002-inch foil scrim kraft facing for air ducts.

C. Type D3: Ductliner rigid board insulation; ASTM C1071; Type II, ‘k’ value of 0.23 at 75 degrees F; 3.0 lb./cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable acrylic surface coating specifically formulated to:

1. Be no more corrosive than sterile cotton when tested in accordance with the test method for corrosiveness in ASTM C665.

2. Absorb no more than 3 percent by weight when tested in accordance with the test method for moisture vapor sorption in ASTM C1104.

3. Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM C1071, ASTM C1338, ASTM G21, and ASTM G22.

4. Show no signs of warpage, cracking, delaminating, flaming, smoking, glowing, or any other visibly negative changes when tested in accordance with the test method for temperature resistance in ASTM C411.

5. Have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.

6. Meet the sound absorption requirements when tested in accordance with the test method for sound absorption in ASTM C423.

7. Show no evidence of continued erosion, cracking, flaking, peeling, or delamination when tested in accordance with the test method for erosion resistance in UL181.

8. Provide rigid fiberglass board equal to Johns Manville Linacoustic R-300 or Owens Corning QuietR Duct Liner Board

D. Type D4: Fire Rated Grease Duct Insulation (High Temperature Flexible Blanket); 1-1/2-inch-thick refractory grade fibrous fire barrier material with minimum service temperature design of 2,000 degrees F; aluminum foil laminated on both sides; with a minimum ‘k’ value of 0.25 and a minimum density of 6 lbs./cu ft; containing no asbestos. Listed by a nationally recognized testing laboratory (NRTL) UL to meet ASTM E 2336, ASTM E119, and with flame spread/smoke minimum rating of 25 / 50 when tested as per ASTM E84/UL 723.

E. Type D5: Outdoor Duct Insulation (Closed Cell Flexible Elastomeric Insulation); 1-inch-thick material that has a service temperature range from –60 degrees F to 180 degrees F. This outdoor duct insulation meets ASTM C 177 or C 518 and shall have minimum ‘k’ value of 0.27 Btu-in. / hr-ft2- degrees F at minimum density measurement of 3 lb/cu ft. The insulation and outside surface must be protected with a white Thermo Plastic Rubber Membrane formulated to:

1. Be resistant to UV, and ozone, acid rain, and physical elements produced from outdoor weather per ASTM E 96 Procedure A.

2. Have aflame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.

3. Show no evidence of continued erosion, delaminating, cracking, flaking, or peeling when tested in accordance with the test method for erosion resistance in UL181. Be resistant to mold growth resistance, ASTM G 21/C 1338 resistant to fungi, and resistant to bacteria growth per ASTM G 22.

F. Type D6: Ductliner rigid glass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable polyacrylate copolymer emulsion specifically formulated to:

1. Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM D 5590 with "0" growth rating.

2. Act as a fungicidal protective coating: water based, VOC < 50 g/l. Fungicidal coating must be EPA registered for use in HVAC duct systems. Manufacturer: H.B. Fuller Construction Products Inc., Foster 40-20 (white) or 40-30 (black) Fungicidal Protective Coating or approved equal. Coatings may also be used to repair damage to duct liner insulation.

3. Provide rigid duct liner equal to Knauf Insulation Performance+® Rigid Plenum Liner, Manson Insulation Akousti-Liner™ R, CertainTeed ToughGard® Duct Liner Board (3# / 3 pcf version), or equal.

G. High Density Duct Insulation Insert, see Type D2.

2.05 INSULATION ACCESSORIES

A. Adhesives: Waterproof vapor barrier type, meeting requirements of ASTM C916; Childers CP-82 or Foster 85-20/85-60.

B. Weather Barrier: Breather Mastic: Childers CP-10/CP-11 or Foster 46-50 White.

C. Vapor Barrier Coating: Permeance - ASTM E 96, Procedure B, 0.08 perm or less at 45-mil dry film thickness, tested at 100F and 50%RH; Foster 30-65 or Childers CP-34

1. When higher humidity levels may be of concern, only specify the following fungus/mold resistant coating: Foster 30-80 AF (anti-fungal). Coating must meet ASTM D 5590 with 0 growth rating**

D. Reinforcing Mesh: 10x10 or 9x8 glass mesh; Foster Mast a Fab or Childers #10

E. Jacket: Pre-sized glass cloth, minimum 7.8 oz/sq yd.

F. Type D4 Insulation Adhesive: Fire resistive to ASTM E84, Childers CP-82 or Foster 85-20.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Joint Tape: Glass fiber cloth, open mesh.

I. Tie Wire and Wire Mesh: Annealed steel, 16 gage.

J. Stainless Steel Banding: 3/4-inch wide, minimum 22 gage, 304 stainless.

K. Armaflex 520, 520 BLV, or Foster 85-75 contact adhesive.

L. Armatuff 25 white seal seam tape.

PART 3 EXECUTION

3.01 GENERAL

A. The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner. Unless otherwise specified to a greater quality, the application of all insulation shall be in accordance with the manufacturer's recommendations.

B. Omit insulation from the following items:

1. Exposed plated plumbing pipe.

2. Vents to atmosphere, discharge from safety and relief valves, overflow pipes, and hot only drain pipes.

3. Valves, unions, flanges, traps, strainers, and devices in HOT ONLY piping.

C. Foil-Faced (FF) Duct Insulation shall comply with NFPA Standards 90A and 90B.

D. All exposed ends of pipe insulation shall be pointed up neatly with appropriate insulating cement, or use pre-molded PVC end caps on cold only piping and preformed aluminum end caps on dual-temp, hot or steam piping.

E. Provide high density insert at duct hangers. Maintain vapor barrier between insulation and duct hanger. Do not insulate duct hangers or supports.

3.02 DUCT AND PIPE PREPARATION

A. Verify that piping and ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

C. Maintain required ambient temperature during and after installation for a minimum period of 24 hours.

3.03 ARMAFLEX PIPE INSULATION

A. Apply in strict accordance with latest edition of Armstrong's "Installation Instructions to the Contractor". Joints and seams shall be sealed moisture tight without gaps and openings in the insulation

3.04 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Extend duct insulation without interruption through walls, floors, and similar penetrations, except where otherwise indicated.

D. Provide external insulation on all round ductwork connectors to ceiling diffusers and on top of diffusers as indicated in the Ductwork Insulation Application and Thickness Schedule and the Drawings. Secure insulation to the top of ceiling diffusers with UL181B-FX listed polypropylene duct tape Do not insulate top of ceiling diffuser if it is used in ceiling return air plenum or in an open space with no ceiling.

E. Flexible and Rigid fiberglass insulation (Types D1 and D2) application for exterior of duct:

1. Secure flexible insulation jacket joints with vapor barrier adhesive, tape. Tape shall be UL181B-FX listed polypropylene duct tape.

2. Install without sag on underside of ductwork. Use 4-inch-wide strips of adhesive on 8-inch centers and mechanical fasteners where necessary to prevent sagging. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3. Insulate standing seams and stiffeners that protrude through the insulation with 1-1/2 inch thick, unfaced, flexible blanket insulation. Cover with reinforcing mesh and coat with vapor barrier finish coating.

4. On circumferential joints, the 2-inch flange on the facing shall be secured with 9/16-inch outward clinch steel staples on 2-inch centers, and taped with minimum 3-inch-wide strip of glass fabric and finish coating.

5. Vapor seal all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh.

F. Duct Liner (Type D3 or D6) application for interior of return air sound boots or return air plenums:

1. Secure insulation with 100 percent coverage of duct liner adhesive, pins and clips not more than 18 inches on center.

2. Secure bottom of duct insulation using alternate single and double clips. The first pin will secure the insulation and the second clip will be used to secure the cladding. Isolate the exterior clip from the cladding by using two 1/8 inch closed cell neoprene (Armaflex) washers on either side of the cladding. Predrill holes in cladding and avoid contact with pin during installation.

3. For round duct, secure insulation with 100 percent coverage of duct liner adhesive. Secure cladding with 3/4-inch, 0.020-inch stainless steel bands on 12-inch centers.

4. For joints and overlaps, fold cladding to form a double thickness hem 2 inches minimum. Seal with a non-shrink, non-hardening sealing compound.

5. Type D6: Provide fungicidal coating in air handlers ten feet on either side, first ten feet downstream of cooling coils, ten feet downstream of mix boxes, in mechanical rooms or as otherwise specified in potentially high humidity areas in the duct system shall be coated with an fungicidal coating; EPA registered for use in HVAC duct systems at a coverage rate of 80 ft2/gallon.

G. Insulation (Type D4) application for exterior of grease ducts:

1. External duct wrap system requires two (2) 1.5-inch layers of lightweight, flexible wrap overlapped to provide an effective fire barrier. The barrier is installed in 24-inch or 48-inch-wide sections. Insulation pins are welded in certain locations to maintain the fire barrier material up against the duct.

2. Grease duct doors to be installed so the door can be removed and re installed and meet code requirements.

3. Install duct wrap as tested per manufacturer's instructions to assure the duct wrap is mechanically attached per the manufacturer's spacing of bands or weld pins.

4. Vertical and horizontal members of the support hanger system shall be wrapped with one layer of the insulation. Vertical and horizontal portions shall be wrapped independent of one another. The horizontal hanger shall be removed from the vertical support rods and wrapped and then immediately replaced so that an adjacent horizontal support can be removed, wrapped, and reinstalled. The end of the threaded vertical rod shall extend 6-inch past the horizontal member at the beginning of the installation.

5. Penetrations: Where ducts penetrate fire rated walls, floors and roofs, the duct wrap shall be used in conjunction with a firestop system that is listed by a nationally recognized laboratory and rated for penetration of a rated wall or floor by the fire rated grease duct system used.

H. Insulation (Type D5) application for outdoor ducts:

1. Horizontal ductwork located outdoors shall be sloped at a minimum 2-degree angle to prevent the accumulation of water on top of the finished insulated duct. Support members that connect directly to the ductwork are to be insulated with this same material. Keep compression or sharp creases of outdoor insulation to a minimum by distributing the weight of the duct resting on horizontal duct support members.

2. Follow the insulation manufacturer's installation instructions and procedures to assure the ductwork is properly insulated and that the insulation will meet the manufacturer's warranty requirements.

I. All ductwork, accessories, and all plenums including metal and masonry construction, etc., shall be insulated as indicated on the Drawings, as specified herein and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.

J. Flexible ductwork connections to equipment shall not be insulated.

K. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.

L. Extreme care shall be taken in insulating high and medium pressure ductwork including all ductwork between the fan discharge and all mixing boxes to ensure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these Specifications are classified as high velocity ductwork.

M. Where canvas finish is specified use lagging adhesive/coating to prevent mildew in securing canvas. Do not use wheat paste. Use only anti-fungal lagging adhesive that adheres to ASTM D 5590 with 0 growth rating. (Foster 30-36AF, Childers CP-137AF). In addition, cover all exterior canvas-covered insulation with a fire-retardant weather barrier mastic.

N. All supply ductwork in the Project shall be insulated; all exhaust and fume hood exhaust ductwork shall not be insulated, unless used for energy recovery purposes or noted on drawings.

O. Flexible round ducts shall be factory insulated.

3.05 INSPECTION

A. Visually inspect the completed insulation installation per manufacturers recommended materials, procedures and repair or replace any improperly sealed joints.

B. Where there is evidence of vapor barrier failure or “wet” insulation after installation, the damaged insulation shall be removed, duct surface shall be cleaned and dried and new insulation shall be installed.

3.06 DUCTWORK INSULATION APPLICATION AND THICKNESS SCHEDULE

Ductwork System	Application	Insulation Type	Insulation Thickness
Supply, Return, Relief, Exhaust Air (Hot, Cold, Combination)	Concealed	D1 UNO	2"
	Exposed	D6	1"
Outside Air	Treated and Untreated	D1	2"
Kitchen Grease Hood Exhaust Air	All	D4	3"
Duct mounted coils	Inside of Mechanical Rooms	D2	2”
Terminal Unit Heating Coils	All	D1	2”
Supply Air Diffusers	Top of ceiling diffuser	D1	2"
Supply Air Duct	Outdoor Environment	D5	2”
Return, Exhaust Air Duct	Outdoor Environment	D5	1-1/2"
Return Air Sound Boots/Elbows/Return Air Ple-nums	All	D6	1"

END OF SECTION 23 0160

SECTION 15184

REFRIGERANT PIPING

PART 1 - GENERAL

1.01 Do not vent refrigerants to the atmosphere. Install new systems using recovering methods. Evacuate and recover existing systems to be modified or removed.

1.02 Submit piping materials, fittings, and refrigeration accessories.

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING:

A. Pipe: Type "K" copper, soft-drawn. Soft-drawn may be used where bending is required on 1-3/8" O.D. and smaller. All other shall be Type "L" Copper, hard-drawn, marked "ACR".

B. Fittings: Wrought copper or forged brass for refrigerant use.

PART 3 - EXECUTION

3.01 REFRIGERANT PIPING:

A. To be installed by machine mechanics skilled in this type work, and in accordance with recognized industry standards.

B. Make joints with "Sil-Fos" backed with nitrogen.

C. Piping and specialties to be sized and installed as recommended by the manufacturer of refrigerant piping.

D. Pre-charged lines may be used with approval of Engineer. These lines shall be installed as recommended by the unit manufacturer. Check and adjust charge after installation.

E. Isolate piping from building structure to prevent transmitting equipment vibration.

F. Installation:

1. Minimum Requirements: Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

2. Testing:

a. General: Every refrigerant containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices,

pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively.

b. Test Medium: Oxygen, or any combustible gas, or combustible mixture of gases shall not be used within the system for testing. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-relief device, and a gage on the outlet side. Set the pressure-relief device above the test pressure but low enough to prevent permanent deformation of the system components.

c. System Test and Charging: Recommended by the equipment manufacturer or as follows:

1) Connect source or refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 10 psig. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

2) Connect a source of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Refer to Table For Test Pressures. Test entire system again for leaks.

3) Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in microns. Pull the system down to 100 microns and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

END OF SECTION

SECTION 230705

HIGH PRESSURE DUCTWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Extent of high-pressure ductwork is indicated on drawings and in schedules, and by requirements of this section. High pressure ductwork is hereby defined as supply ductwork between air handling units and terminal air boxes, see drawings for pressure classes.

1.02 QUALITY ASSURANCE:

A. Installer: A firm with at least 3 years of successful installation experience on projects with high pressure ductwork systems work similar to that required for project.

B. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards" for fabrication and installation of high-pressure ductwork.

C. ASHRAE Standards: Comply with ASHRAE Handbook, 1988 Equipment Volume, Chapter 1 "Duct Construction," for fabrication and installation of high-pressure ductwork.

D. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

E. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards - current edition."

1.03 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork and duct sealants, used for work of this section.

B. Submit duct leakage tests.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosure with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS:

A. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock-forming quality, with ANSI/ASTM A 525, G90 zinc coating; mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIAL:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch take-off connections. Where 90-degree branches are indicated, provide conical type tees.

C. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

D. Duct Cement: Non-hardening, migrating mastic or liquid neoprene based cement (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

E. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. Except where space is indicated as "High-Humidity area, interior support materials of not less than 1/4" diameter or 3/16" thickness may be plain (not galvanized).

2. For exposed stainless-steel ductwork, provide matching stainless steel support materials.

F. Flexible Duct: Furnish and install where indicated on the drawings semi-rigid lightweight aluminum duct. Duct to be manufactured using a soft aluminum strip which is spirally wound and mechanically joined. Duct to be listed under UL #181 Class 1 and NFPA 90A. Insulation shall be 1-1/2” thick, ¾ lb. density fiberglass blanket, maximum “K” value of 0.25 btu-in/hr.-ft-F and vapor barrier shall be metalized Mylar film. Semi-rigid duct shall be rated for 12” positive and 12” negative static pressure. Duct to be equal to Flexmaster Type TL-M. Vinyl or non-aluminized vapor barriers will not be allowed. Maximum runouts shall not exceed lengths indicated on drawings.

G. Access Doors: Access doors in high velocity ducts shall be equal to Semco Type 5-3I. Door shall be rated for installation in duct systems with pressures up to 8 in w.g. Where required for fire dampers, door shall be furnished as a factory fabricated unit along with extended sleeve and fire damper (installed downstream of fire reinforced corners). Door shall be 20 gage galvanized steel sheet with 1”-inch-thick foil faced duct liner insulation, sandwiched to 22 gage perforated inner liner. Door panel shall have spring clips designed to relieve a minimum of 150 cfm at 2-1/2" negative. Panels shall be: 12" x 12" on ducts less than 12" diameter; 12" x 18" on ducts from 12" to 24" diameter; and 18" x 18" on ducts from 26" to 36" diameter.

2.03 FABRICATION:

A. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs.

B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Standards."

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

2.04 FACTORY-FABRICATED DUCTWORK:

A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Round Ductwork:

1. Construct of galvanized sheet steel complying with ANSI/ASTM A 527 by the following methods and in minimum gages listed.

DIAMETER	MINIMUM GAGE	METHOD OF MANUFACTURE
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
over 60"	16	Longitudinal Seam

2. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

3. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

DIAMETER	MINIMUM GAGE
3" to 36"	20
38" to 50"	18
Over 50"	16

C. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lockseam construction, in minimum gages listed.

MAXIMUM WIDTH	MINIMUM GAGE
Under 25"	24
25" to 48"	22
49" to 70"	20
Over 70"	18

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams.

MAXIMUM WIDTH	MINIMUM GAGE
Up to 8"	22
8" to 37"	20
37" to 50"	18
Over 50"	16

D. Internally Insulated Duct and Fittings: Construct with outer pressure shell, 1" thick insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lockseam construction (use longitudinal seam for over 59"), in minimum gages listed.

ROUND NOMINAL DUCT

DIAMETER	OUTER SHELL	INNER LINER
3" to 12"	26 ga.	28 ga.
13" to 24"	24 ga.	28 ga.
25" to 34"	22 ga.	28 ga.
35" to 48"	20 ga.	28 ga.
49" to 58"	18 ga.	28 ga.
Over 59"	16 ga.	28 ga.

FLAT OVAL OUTER DUCT

MAJOR AXIS	OUTER SHELL	INNER LINER
To 12"	26 ga.	28 ga.
13" to 24"	24 ga.	28 ga.
25" to 34"	22 ga.	28 ga.
35" to 48"	20 ga.	28 ga.
49" to 58"	18 ga.	28 ga.

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams of outer shell.

2. NOMINAL DUCT

DIAMETER	OUTER SHELL	INNER LINER
3" to 34"	20 ga.	20 ga.
36" to 48"	18 ga.	20 ga.
Over 48"	16 ga.	20 ga.

3. Inner Liner: Perforate with 3/32" holes for 22% open area. Provide metal spacers welded in position to maintain spacing and concentricity.

4. Hospital grade insulation shall completely fill the 1" space between the liner and the outer shell and shall have the following UL ratings:

Flame Spread	10-20
Fuel Contributed	10-15
Smoke Developed	10-20

5. At the end of an insulated section or run, where internally insulated duct connects to insulated spiral duct or fittings, fire damper or flex, a manufactured insulation end fitting shall be installed to bring the outer pressure shell down to nominal size.

E. Fittings shall be equal to Semco Mfg., Inc. machine formed fittings as follows:

1. 90-degree elbow - 10 inch and smaller E901
2. 45-degree elbow - 10 inch and smaller E451
3. 90-degree elbow - over 10-inch E905
4. 45-degree elbow - over 10-inch E453
5. 90-degree conical tee ..... CT
6. 90 degrees reducing conical tee ..... CTR
7. 180-degree conical cross CC
8. 180 degrees conical cross, reducing ..... CCR
9. 45-degree lateral L
10. 45-degree double lateral cross LC
11. 45 degrees reducing lateral ..... LR
12. 45 degrees double reducing lateral ..... LDR
13. Two-way "Y" ..... WYE
14. Concentric Reducer ..... RC
15. Non-Concentric Reducer ..... RE
16. Coupling (Male) ..... CPL-M
17. Coupling (Female) ..... CPL-F
18. Offset ..... OFF
19. Round to Oval Transition (Concentric) ..... RC
20. Round to Oval Transition (Non-Concentric) ..... RE

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:

1. Semco, Inc.
2. McGill Airflow, LLC.
3. Spiral Pipe of Texas

PART 3 - EXECUTION

3.01 INSTALLATION OF DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve an airtight system and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true-to-shape and to prevent buckling.

3.02 DUCT SEALING

A. Seal supply, return and exhaust ductwork per SMACNA high pressure standards with mastic equal to "Hard Cast" FTA-20 with DT tape for indoor use and RTA-50 with DT tape for outdoor use.

1. Seal per SMACNA Standards to achieve airtight system.

2. Duct Seal Levels:

Duct Location	Duct Type		
	Supply	Exhaust	Return
Outdoors	A	A	A
Unconditioned Spaces	A	B	B
Conditioned spaces (concealed ductwork)	B	B	B
Conditioned spaces (exposed ductwork)	B	B	B
Lab and Animal Room Exhaust		A	A

3. Seal Level Description:

Seal Level	Sealing Requirements
A	All transverse joints, longitudinal seams, and duct wall penetration
B	All transverse joints and longitudinal seams
C	Transverse joints only

4. Seal ductwork, after installation, in accordance with recommendations of SMACNA Standards.

5. All high velocity ductwork joints shall be either welded or joint shall be sealed.

6. Water-Based Joint and Seam Sealant:

   a. Application Method: Brush on.

   b. Solids Content: Minimum 65 percent.

   c. Shore A Hardness: Minimum 20.

   d. Water Resistant.

   e. Mold and Mildew Resistant.

   f. VOC: Maximum 75g/L (less water).

   g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

   h. Service: Indoor or Outdoor.

   i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

7. Flanged Joint Sealant: Comply with ASTM C 920.

   a. General: Single-component, acid curing, silicone, elastomeric.

   b. Type: S.

c. Grade: NS.

d. Class: 25.

e. Use: O.

B. Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work. Drilled expansion anchors selected and installed as directed by manufacturer may be used. Expansion anchors shall be equal to "Phillips Red Head", verify with structural engineer that drilled anchors are suitable for the deck design.

C. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Where possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

E. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

F. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".

G. Where ducts pass through fire-rated floors, walls, or partitions, install fire dampers, provide firestopping between duct and substrate.

H. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Support ductwork in manner complying with SMACNA "HVAC Duct Standards."

3.03 CLEANING AND PROTECTION:

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.04 TESTING FOR LEAKAGE:

A. General: After each duct system is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual, 1995 Edition. Repair leaks and repeat test until total leakage is less than limits outlined in the manual.

END OF SECTION

SECTION 23 0710

HVAC SHEET METAL

PART 1 - GENERAL

1.01 SCOPE:

A. All low pressure duct work including supply, exhaust, and outside air to complete the systems as shown on the Drawings or specified herein.

1.02 SUBMITTALS:

A. Submit the following:

1. Air distribution devices.
2. Life safety dampers and doors.
3. Flexible duct.
4. Flexible connections.
5. Access doors and duct access doors.
6. Turning vanes.
7. Duct take-off, fittings.
8. Roof outside air intake.
9. Duct sealants.
10. Duct leak tests.

1.03 GOVERNING PUBLICATIONS AND AUTHORITIES:

A. ASHRAE "Guide".

B. SMACNA "Low Velocity Duct Construction Standards".

C. Underwriters' Laboratories, Inc.

D. NFPA Pamphlets No. 90A, 90B, 91 and 96.

PART 2 - PRODUCTS

2.01 DUCT MATERIALS:

A. Galvanized steel sheets shall be lock-forming quality (LFQ), shall have a galvanized 690 zinc coating of 1-1/4 oz. total for both sides of one square foot, and the gauge of galvanized steel sheets shall be as prescribed by the latest edition of SMACNA for pressure classification of ductwork.

B. Aluminum sheets shall be made from an aluminum base alloy having not more than 0.5%

copper (for corrosion resistance), a minimum tensile strength of 16,000 psi and the ability to satisfactorily make a Pittsburgh lock seam without splitting.

2.02 FLEXIBLE CONNECTIONS:

A. Flexible connections shall be made on duct connections of air moving equipment greater than 2000 CFM or as required for equipment installation.

B. Connections shall be made of 30-ounce woven glass fabric; fire-, water-, and weather-resistant fabric equal to “Ventfab”, double coated with neoprene "Ventglas", or equal. Canvas connections to give no less than 3" clear break between metals jointed. Insulate with 1" minimum fiberglass duct wrap with a vapor barrier facing of foil reinforced kraft. Seal with reinforced aluminum tape.

C. Flexible connections on exterior shall be protected from weather with sheetmetal cover which shall be coated for protection same as ductwork.

D. Connections in high pressure systems, fume hoods, and for those exposed to the weather shall be made from "Ventglas", neoprene coated glass fabric.

2.03 ACCESS DOORS:

A. Access doors to 16" by 24" size shall be "Ventlock" stamped insulated access doors.

B. Larger access doors shall be double panel construction with one inch thick 1.5 pcf density rigid insulation between panels. Doors with largest dimension over 24", but less than 48", shall use "Ventlock" series 200 latches, hinges and gasketing, and construction shall be 22 gage galvanized steel. Doors with largest dimension over 48" shall use "Ventlock" series 300 latches, hinges and gasketing, and construction shall be 20 gage galvanized steel.

C. Provide vision panels on access doors for fire dampers and control dampers.

2.04 FLEXIBLE DUCT:

A. Low Pressure: furnish and install, where indicated on the drawings, flexible metal insulated round ductwork, factory fabricated, listed under U.L. #181, Class 1 and NFPA 90A, capable of a minimum centerline bend radius equal to duct inside diameter. Insulation shall be 1-1/2" thick, 3/4 lb. density fiberglass blanket, maximum "K" value of 0.25 btu-in/hr-ft5-EF., and vapor barrier shall be neoprene coated fiberglass fabric laminated to aluminized polyester film. Flexible duct shall be rated for 10" positive and 2" negative static pressure.

B. Vinyl or non- aluminized vapor barriers will <u>not</u> be allowed. Maximum runouts shall not exceed length indicated on drawings in notes or details.

2.05 AIR DISTRIBUTION DEVICES:

A. General:

1. All outlet grilles shall have gaskets.

2. Furnish opposed blade volume controls on all supply outlets and return grilles.

B. Devices: Devices shall be as scheduled on the drawings.

2.06 LIFE SAFETY DAMPERS:

A. Dampers shall be equal to those manufactured by the Ruskin Corporation or Greenheck.

B. Dampers shall be U.L. listed.

C. Fire, smoke or combination fire/smoke dampers shall be provided in rated assemblies requiring them.

D. All dampers, methods and location of installation shall comply with the requirements of the International Building Code, National Fire Protection Association and all authorities having jurisdiction. In the case of discrepancies, most stringent requirements shall dictate installation.

E. Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. Access shall be provided on either side of damper assemblies.

F. Access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly.

G. Provide access door minimum 12" x 12".

H. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch (12.7 mm) in height reading: fire/smoke damper, smoke damper or fire damper.

I. Access doors in ducts shall be tight fitting and suitable for the required duct construction. Contractor shall install dampers in accordance with the following:

J. Fire dampers shall be constructed and tested in accordance with UL Safety Standard 555. Dampers shall have an hourly rating as indicated on the drawings, a 212°F fusible link, and shall include a UL label.

K. All outlet grilles shall have gaskets.

L. Contractor shall furnish opposed blade volume controls on all supply outlets and return grilles.

M. Dampers shall be equipped for vertical or horizontal installation as required by the location.

N. Manufacturer’s integral sleeves and frames may be used at the contractor's option.

O. Dampers shall be provided which are tested and rated for design duct velocity and pressure.

P. Dampers rating shall meet or exceed the rating of the wall in which it is housed.

Q. Contractor shall install fire or smoke or combination dampers in all rated walls as necessary to maintain the integrity of all rated walls whether indicated on the plans or not.

2.07 ACCESSORIES:

A. Manufactured Turning Vanes: Furnish and install single thickness, multiple radius, airfoil steel turning vanes. Static pressure loss for square ducts shall be no more than 20% of velocity head. Turning vanes shall be furnished with a mounting plate to facilitate installation in ductwork.

B. Manual Balancing Damper:

1. Square or Rectangular: Minimum 16 ga. body and 18 ga. blades, equal to Ruskin or Greenheck with vinyl blade seal and locking hand operator quadrant.

2. Round: Minimum 20 ga. body and 22 ga. blades, equal to Ruskin or Greenheck with locking hand operator

C. Control Dampers:

1. Control dampers shall be furnished by AHU Manufacturer or Control System.

D. All dampers shall be capable of 100% seal off.

PART 3 - EXECUTION

3.01 GENERAL:

A. All ductwork not specifically indicated on drawings or specified elsewhere to be high-pressure duct shall be fabricated, braced and erected in accordance with SMACNA "Low Velocity Duct Construction Standard" or the latest edition of ASHRAE "Guide".

B. Ductwork shall be galvanized steel unless otherwise noted.

C. Stainless steel and aluminum ductwork shall welded seam.

D. Adhere to drawings as closely as possible. However, where required to meet structural or other interferences vary the run and shape of ducts and make offsets during progress of work. Duct routes shall be established and field measurements shall be taken before duct work is fabricated. Where pipes or other items are "taken-in" to the duct, streamline collars shall be formed and placed around the item. If collar obstructs more than 20% of the cross-sectional area, the duct shall be enlarged to accommodate obstruction.

E. All changes of direction and elbows shall be fitted with turning vanes. Standard radius elbows may be used if space permits.

F. Ductwork shall be free of any objectionable self-generating noise or rattles.

G. Furnish and install shop fabricated ductwork. Pre-assemble work in shop to the greatest extent possible, so as to minimize field assembly of systems. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

H. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

I. Duct Sealing: All ductwork, regardless of system pressure classification, shall be sealed in accordance with Seal Class A, as referenced in SMACNA Standards. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.

1. All seams and joints in shop and field fabricated ductwork shall be sealed by applying duct sealant complying with manufacturer’s recommendations. Tapes recommended by the sealant manufacturer may be used in addition to sealant to achieve leakage limit requirements.

2. Sealant shall be water based latex UL 181A-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be Hard Cast Iron Grip 601, Ductmate Pro Seal, Foster 32-19, Childers CP-146 or Design Polymerics DP 1010.

3. Sealing tapes shall be from the same manufacturer as duct sealants.

4. Sealer shall be rated by the manufacturer and shall be suitable for use at the system pressure classification of applicable ductwork.

5. Except as noted, oil or solvent-based sealants are specifically prohibited.

6. For exterior applications, “Uni-Weather” (United McGill Corporation), solvent-based sealant, or Foster 32-19 shall be used.

J. Support materials shall be hot dipped galvanized steel fasteners, anchors, rods, straps, trim and angles. (Support duct with all thread rods and unistrut as equal trapeze hangers).

K. Install air flow measuring stations, furnished by Control Contractor, where indicated on the drawings.

3.02 MANUAL BALANCING DAMPERS:

A. All low pressure branch ducts on either supply, return or exhaust shall be provided by some means of balancing in addition to dampers at registers.

B. Splitter dampers shall be made of at least the same thickness material as duct (minimum thickness 22 gage). They shall be securely hinged at air leaving edge and made of 2 thicknesses so that entering edge presents a rounded surface to air flow.

C. Butterfly dampers shall be made of 16 gage galvanized steel. Butterfly dampers may be used in widths up to 10" wide. Dampers that require blades over 10" wide shall be multi-blade louver dampers.

D. Multi-blade louver dampers used for balancing shall be of the opposed blade type. Damper blades shall be constructed of 16 gage steel. Individual blade width shall not exceed 10" and blade length shall not exceed 48".

E. All dampers shall be so constructed and installed that there shall be no vibration due to air flow over damper.

F. Extend all handles and levers to outside of insulation.

3.03 ACCESS DOOR:

A. Access doors shall be provided at all dampers, equipment in duct and as indicated on drawings.

B. Access doors shall be minimum of 12" X 12" unless a larger size is required for maintenance of equipment or a smaller size must be used because of small duct size.

C. Provide access doors at all fire dampers, smoke dampers, humidifiers, and as indicated on the drawings.

3.04 FLEXIBLE CONNECTIONS:

A. Furnish and install sound isolating flexible connections on the inlet and outlet of each fan and unit to which duct connectors are made.

B. At least one inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork.

C. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

3.05 FLEXIBLE DUCT

A. Maximum runout shall not exceed lengths indicated on drawings.

B. Ducts shall be supported at intervals indicated in SMACNA and not laid on top of ceiling.

C. Minimum bend radius shall be as recommended by manufacturer.

D. Ducts shall be run straight and true with minimum offsets, and with excess duct lengths removed.

E. Connections to ducts and air devices shall be with minimum of one duct diameter straight into connection (kinked or pinched installations restricting flows are not acceptable).

F. Connections to duct and air devices shall be air tight.

3.06 TESTS:

A. Test duct systems in accordance with SMACNA latest edition of HVAC Air Duct Leakage Test Manual to achieve air tight systems not exceeding the limits outlined in the manual. Submit test results.

END OF SECTION

SECTION 230895

AIR TERMINAL DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Extent of air terminals work required by this section is indicated on drawings and schedules and by requirements of this section.

1.02 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ADC Compliance: Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.

2. AHRI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems."

1.03 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air terminals which may be incorporated in the work include, but are not limited to, the following or equal:

1. Manufacturer: Subject to compliance with requirements, provide air terminals of one

a. Titus

b. Tuttle-Bailey

c. Price

d. Kreuger

2.02 AIR TERMINALS – SUPPLY AND EXHAUST

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Terminals shall be pressure independent type. Provide with cross-shaped flow sensor, and factory damper ready for installation of box damper actuator and electronic controller provided by control system manufacturer.

C. The casing shall be constructed of coated steel meeting SMACNA or ASHRAE Standards. Internal insulation shall meet the requirements of NFPA Bulletin 90A and UL 181. Boxes shall have solid galvanized sheet metal liner.

D. Terminal box shall have 24 volt control voltage provided by control system manufacturer. (Spec writers coordinate with Elec. Engr. To provide necessary 120V circuits to control system transform.)

E. Furnish each supply air terminal with heating coil as specified on the drawings. Hot water coils shall be a minimum of two rows.

F. Control system contractor shall provide readout at the graphical computer interface of the following points:

1. Airflow, CFM

2. Box damper position, and commanded % open.

3. Leaving air temperature, supply terminal only.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF AIR TERMINALS:

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Label: Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 2300075 "Mechanical Identification" for equipment labels and warning signs and labels.

3.03 FIELD QUALITY CONTROL:

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.04 CLEANING:

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 0990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY:

A. This section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities and temperatures of the mechanical systems as required to meet design specifications, and recording and reporting the results.

1. Test, adjust, and balance the following mechanical systems:

a. Supply air systems, all pressure ranges.

b. Return air systems.

c. Exhaust air systems.

d. Outside air systems.

e. Verify control system operation.

2. Contractor shall:

a. Put heating, ventilating, and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.

b. Allow the air balance agency to schedule this work in cooperation with other trades involved and comply with the completion date.

c. Make available to the balance agency a complete copy of submittal data on mechanical equipment including pump performance curves, fan curves, manufacturer's balancing factors and other manufacturers ratings for installed equipment.

d. Make any changes in pulleys, belts, and dampers or the addition of dampers as required for correct balance as recommended by TAB Contractor, at no additional cost to the Owner.

e. Have strainers and filters clean prior to starting of testing and balancing activity.

B. This section does not include:

1. Specifications for materials for patching mechanical systems.

2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

3. Requirements and procedures for piping and ductwork systems leakage tests.

1.02 DEFINITIONS:

A. Systems testing, adjusting, and balancing is the process of checking and adjusting building environmental systems to produce design objectives. It includes:

1. Balance of air distribution;

2. Adjustment of total system to provide design qualities;

3. Electrical measurement;

4. Verification of performance of equipment and automatic controls;

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttle valves and dampers) to proportional flows within the distribution system (mains, branches, and terminals) according to specified design quantities.

D. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting and balancing.

E. Terminal: The point where controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

1.03 SUBMITTALS:

A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Technicians Data: Submit proof that the Test and Balance Staff assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems.

E. Sample Forms: Submit sample forms.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Technician. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to

establish normal operating values of the systems. Follow the procedures and format specified below.

G. Draft Reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

H. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.

I. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide contents of binder into the below listed divisions, separated by divider tabs:

1. General Information and Summary

2. Air Systems

3. Temperature Control Systems

J. Report Contents: Provide the following minimum information, forms and data:

1. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor and Project. Include addresses, and contact names and telephone numbers. Also include a sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Technician. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

2. The remainder of the report shall contain the appropriate forms for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

3. Air systems report shall include the following:

   a. blower RPM;

   b. motor full load amperes and voltages; system static pressures, suction and discharge;

   c. cfm outside air (for demand-controlled ventilation with CO2 sensors, provide airflow readings at 2 different CO2 levels;

   d. entering air temperatures; DB/WB

   e. leaving air temperatures; DB/WB

   f. main supply, return, and exhaust air ducts cfm, (pitot transverse);

g. each diffuser, grille and register cfm. (Balance to within +/-10% of design requirements and pressure relationships shown on drawings.)

h. each grille, diffuser, and register shall be identified as to location and area;

i. copies of start-up logs;

j. space temperatures and humidity readings; DB/WB

k. pressure drops across coils, filters, dampers, and other equipment in ducts.

l. pressure profiles of each system.

m. sheave size, brand name, and number.

n. belt quantity, stock name, and number.

K. Calibration Reports: Submit proof that required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of 6 months prior to starting the project.

1.04 QUALITY ASSURANCE:

A. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

2. The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureaus (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Technician, certified by NEBB or AABC.

B. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

2. AABC: "National Standards for Total System Balance".

3. ASHRAE: ASHRAE Handbook, Current Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

C. Pre-Balancing Conference: Prior to beginning testing, adjusting, and balancing procedures, schedule and conduct a conference with the Contracting Officer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.05 PROJECT CONDITIONS:

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.06 ACCEPTANCE:
The Contracting Officer will not accept the building until the systems have been properly started, balanced, and the TAB Report is approved.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

3.01 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:
Before operating the system, perform these steps:

A. Obtain design drawings and specifications and become thoroughly acquainted with design intent.

B. Obtain copies of approved shop drawings of air handling equipment, outlets (supply and return) and temperature control diagrams.

C. Compare design to installed equipment and field installations.

D. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

E. Check filters for cleanliness.

F. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

G. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

H. Determine best locations in main and branch ductwork for most accurate duct traverses.

I. Place outlet dampers in fully open position.

J. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

K. Verify that motors and bearings have been lubricated.

L. Check fan belt tension.

M. Check fan rotation.

3.02 MEASUREMENTS:

A. Provide required instrumentation to obtain proper measurements, calibrated to the tolerances specified in referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

3.03 PERFORMING TESTING, ADJUSTING, AND BALANCING:

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar control and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.04 CONTROL SYSTEM VERIFICATION:

A. In conjunction with Control System Vendor, during the process of TAB work, manipulate control system devices as required to facilitate necessary system TAB. Provide listing of control system components and/or sequences that are not operating properly in TAB report and to Control System Vendor.

3.05 RECORD AND REPORT DATA:

A. Record data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by referenced standards, and as approved on sample report forms.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.06 DEMONSTRATION:

A. Training:

1. Train maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with personnel the information contained in Operating and Maintenance Data.

2. Schedule training through the Owner with at least 7 days' prior notice.

END OF SECTION

SECTION 239000

AUTOMATIC CONTROL SYSTEM

PART 1 GENERAL

1.01. WORK INCLUDED

A. Furnish a totally native BACnet-based system. Control system shall be an addition to and an extension of the existing campus Building Automation System.

B. System

1. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications.

2. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

3. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.

4. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.

5. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

6. Provide and install all interconnecting cables between all equipment controllers.

7. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

8. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.

9. Provide a comprehensive operator and technician training program as described herein.

10. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

11. All measurable points on each piece of hardware, duct, or equipment monitored by the building control system shall be made available to view, control, and trend from the user interface.

1.02. SYSTEM DESCRIPTION

A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet. This system is to control all mechanical equipment, using native BACnet-

compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.

B. Room sensors shall be provided with digital readout that allow the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode.

1.03. APPROVED MANUFACTURERS

A. Siemens or approved equal.

1.04. QUALITY ASSURANCE

A. Responsibility: The supplier of the EMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.

B. Component Testing: Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.

C. Tools, Testing and Calibration Equipment: The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

D. The systems control contractor shall have been in business a minimum of five years and be the authorized installing contractor for the manufacturer of the BACnet components.

E. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 75 miles of project site.

1.05. SUBMITTALS

A. Drawings

1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.

2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).

3. Eight complete sets (copies) of submittal drawings shall be provided.

4. Drawings shall be available on CD-ROM.

1.06. WARRANTY

A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.

B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours Monday through Friday, 48 hours on Saturday and Sunday.

C. This warranty shall apply equally to both hardware and software.

PART 2 PRODUCTS

2.01. BACnet APPLICATION EQUIPMENT CONTROLLERS

A. Provide one or more native BACnet application controllers for each controlled piece of equipment. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident at the operator workstation.

B. BACnet Conformance

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:

a. Files Functional Group

b. Reinitialize Functional Group

c. Device Communications Functional Group

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator’s terminal. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs from the

Touch Screen Interface.

E. Application controller shall include support for intelligent room sensor (see section 2.9.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor.

2.02. OPERATOR'S WORKSTATION

A. Contractor shall furnish and install (1) new operator workstation and associated software for graphical user interface (GUI).

2.03. SENSORS and MISCELLANEOUS DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount top of thermostat at approximately 44 inches above finished floor, align with light switch of associated room. Duct sensors to be installed such that the sensing element is in the main air stream.

B. Room Sensor with LCD Readout

1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.

2. Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application.

3. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.

2.04. ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.

C. Enclosures shall have hinged, locking doors.

D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.

PART 3 EXECUTION

3.01. EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until all unsatisfactory conditions are resolved.

3.02. INSTALLATION (GENERAL)

A. Install in accordance with manufacturer's instructions.

B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.03. INTERLOCKING AND CONTROL WIRING

A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.

B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.

C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.

D. Provide auxiliary pilot duty relays on motor starters as required for control function.

E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.

F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

3.04. TRAINING

A. Provide application engineer to instruct owner in operation of systems and equipment.

B. Provide on-site training above as required, up to 8 hours as part of this contract.

END OF SECTION

SECTION 260000 - ELECTRICAL - GENERAL PROVISIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials and equipment required and install complete and make operational, electrical system as shown on the Drawings and as specified herein.

B. The work shall include the following:

1. Coordinate the electrical service requirements with the power company and provide the electrical service(s) from the Power Company at the locations indicated.

2. Provide conduit, wire and field connections for all equipment, HVAC systems, panelboards, transformers, and electrical equipment furnished under Divisions 1, 11, 21, 22, 23, and 26.

C. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this sub-bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

2.1 SUBMITTALS

A. As a minimum all equipment specified in each Section of Division 26 shall be submitted at one time. As an example all lighting fixtures shall be submitted together, all motor control centers shall be submitted together, etc. Submittals that do not comply will be returned disapproved.

B. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude parts not applicable to the project. When manufacturer’s cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submittal piece of literature and each submittal drawing shall clearly reference the Project Specification and/or Contract Drawing that the submittal is to cover. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.

C. Check shop drawings for accuracy prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to this Section and the Drawings. This statement shall also list all exceptions to this Section and the Drawings. Mark submittals to identify proposed equipment including accessories, options and features being proposed for approval and exclude parts not to be used. Shop drawings not so checked and noted shall be returned marked NOT APPROVED.

D. The Engineer's check shall be for conformance with the design concept of the project and compliance with this Section and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by this Section and the Drawings.

E. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

F. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked “APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."

G. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 017823. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists including replacement part numbers, to instruct operating and maintenance personnel unfamiliar with such equipment.

2. Manuals shall include the following as a minimum:

a. A complete "As-Built" set of approved shop drawings.

b. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

c. Detailed service, maintenance and operation instructions for each item supplied.

H. Exceptions for Submittals

1. Exceptions to the Specifications or Drawings shall be clearly defined by the Electrical Subcontractor in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an “or equal” or “exception” to the Specifications shall be at the sole discretion of the Engineer.

I. Submittals will be returned to the Contractor under one of the following codes.

Code 1 -"APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 -"APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 -"APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may, at his own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 10 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 -"APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

Code 5 -"NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 -"COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 -"RECEIPT ACKNOWLEDGED" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval; and, is being filed for informational purposes only. This code is generally used in acknowledging receipt of *means and methods of construction* work plan, field conformance test reports, and Health and Safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

3.1 REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the National Electrical Code (NEC).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

4.1 PRIORITY OF THE CONTRACT DOCUMENTS

A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or

association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.

E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times

5.1 SERVICE AND METERING

A. Service will be obtained at 480 Volts, 3Phase, 4Wire, 60 Hz.

B. The Contractor shall be responsible for the following work:

1. Obtain an estimate from the power company for the work described above and include the cost of the power company work in the Bid Price.

2. Make all arrangements with the power company for obtaining electrical service, pay all power company charges.

6.1 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

7.1 INTERPRETATION OF DRAWINGS

A. Unless specifically stated to the contrary, the Drawings do not show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

B. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.

C. Conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Unless otherwise indicated install branch circuit conduits exposed in process/ industrial type spaces and concealed in finished spaces.

D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation. Where home-runs indicate conduit is to be installed concealed or exposed the entire branch circuit shall be installed in the same manner.

E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to

the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials to install and place in satisfactory operation all power, lighting and other electrical systems shown.

H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

I. Raceways and conductors for low voltage (120 Volts) thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment and the motor starters for a complete and operating system. Raceways shall be installed concealed in all finished space and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats.

8.1 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which electrical equipment furnished under Division 26 must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

9.1 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings."

10.1 MATERIALS AND EQUIPMENT

A. Materials and equipment furnished under this contract shall be new.

B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

11.1 EQUIPMENT IDENTIFICATION

A. Identify equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 26 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

PART 2 EXECUTION

1.1 INSTALLATION

A. Work not installed according to the Drawings and Specification shall be subject to change as directed by the Engineer at Contractor's expense.

B. Electrical equipment shall be protected against mechanical and water damage. Store all electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.

C. Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion and at the Contractor's expense.

D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer.

2.1 WORK SUPERVISION

A. The Contractor shall designate in writing the qualified electrical supervisor who shall provide supervision to all electrical work on this project. The minimum qualifications for the electrical supervisor shall be a master electrician as defined by the Arkansas Board of Electrical Examiners. The supervisor or his appointed alternate possessing at least a journeyman electrician license shall be on site whenever electrical work is being performed. The qualifications of the electrical supervisor shall be subject to approval of the Owner and the Engineer.

B. All master and journeyman electricians shall be licensed in accordance with Arkansas Code Title 17 Chapter 28 - Electricians. The website located at http://www.arkleg.state.ar.us publishes the text of this statutory requirement. No unlicensed electrical workers shall perform work on this project. Apprentice electricians in a ratio of not more than one apprentice per journeyman electrician will be allowed if the apprentices are licensed and actively participating in an apprenticeship program recognized and approved by the Arkansas Board of Electrical Examiners.

END OF SECTION 260000

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
2. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. 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. Cerro Wire LLC.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. 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. Cerro Wire LLC.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with long barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper or aluminum as noted on plans; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

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

1. Burndy; Part of Hubbell Electrical Systems.
2. O-Z/Gedney; a brand of Emerson Industrial Automation.
3. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Conductors shall be as specified under Section 260519 “Low-Voltage Electrical Power Conductors and Cables.”

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install barecopper conductor, **No. 4/0** AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches 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.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes;

use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101

B. Comply with requirements in "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS SP-58,Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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

a. Allied Tube & Conduit; a part of Atkore International.
b. Republic Conduit.
c. Thomas & Betts Corporation; A Member of the ABB Group.

2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

a. Comply with NEMA RN 1.
b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

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

   a. Allied Tube & Conduit; a part of Atkore International.
   b. Republic Conduit.
   c. Thomas & Betts Corporation; A Member of the ABB Group.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:

   a. Material: Steel.
   b. Type: Compression.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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

   a. CANTEX INC.
   b. RACO; Hubbell.
   c. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

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

   a. CANTEX INC.
   b. RACO; Hubbell.
   c. Thomas & Betts Corporation; A Member of the ABB Group.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.

3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 based on installation location, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

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

1. Crouse-Hinds, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Hubbell Incorporated; Wiring Device-Kellems.
4. Thomas & Betts Corporation; A Member of the ABB Group.
5. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

L. Gangable boxes are prohibited.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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

a. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Electrical rooms
    e. Welding and Advanced Manufacturing Area for any exposed conduit up to 8’ above finished floor

2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: GRC.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

H. Panel feeders shall not be installed on roofs unless specifically noted on plans or approve via RFI to engineer.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Raceways installed on roof shall be kept a minimum of 1” above roof deck and shall be supported using Dura-Blok rooftop supports with maximum spacing of 10’ between supports.

D. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

E. Do not fasten conduits onto the bottom side of a metal deck roof.

F. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

G. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inchesof enclosures to which attached.

M. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

N. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

U. Mount boxes at heights indicated on Drawings or in Specification 262726 “Wiring Devices”. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

X. Locate boxes so that cover or plate will not span different building finishes.

Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

AA. Set metal floor boxes level and flush with finished floor surface.

BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
3. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

260548 - SEISMIC RESTRAINT FOR ELECTRICAL COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.

Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

1.2 DESCRIPTION

This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II, III, & IV structures, including, but not limited to:

1. Electrical Components: Transformers, Switchboards, UPS, ATS, Panel Boards, Generators, Mufflers, Day Tanks, Switchgear, Lighting, etc.

Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

1.3 DEFINITIONS

Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.

Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.

Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.

Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.

Component Importance Factor (I_p): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.

Consequential Damage: Failure of an essential component caused by the failure of a separate essential or non-essential component due to the functional and physical interrelationship of the components, their supports, and their effect on each other.

Designated Seismic System: Those nonstructural components that require design in accordance with Chapter 13 of ASCE 7, for which the Component Importance Factor (Ip) is 1.5 in accordance with Section 13.1.3 of ASCE 7.

Special Seismic Certification: A certificate of compliance, supplied by the manufacturer of Active Designated Seismic Systems, which certifies that the equipment will remain operable during the design seismic event. Components with hazardous contents shall be certified as maintaining containment following the design seismic event.

Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.

Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

1.4 REGULATORY REQUIREMENTS

Comply with the 2018 International Building Code (IBC) and applicable local adopted amendments, and the 2010 Edition on ASCE 7 (ASCE 7-16).

1.5 DESIGN PERFORMANCE CRITERIA

Provide seismic restraint of components to withstand seismic forces and displacements without displacing or overturning. Design of seismic restraint shall be performed in accordance with the 2018 International Building Code and ASCE 7-16, as follows.

1. Seismic forces shall be determined in accordance with Chapter 13 of ASCE 7-16. The seismic design parameters shall be as noted in the project Structural drawing. The assigned Component Importance Factors (Ip) for each component, shall be as noted on the project drawings and/or specifications.

2. For components installed on the exterior of the building, wind forces shall be determined in accordance with Chapter 29 of ASCE 7-16, except that the uplift forces per Equation 29.5-3 shall be considered regardless of the building height. Reference the Structural drawings for wind design criteria.

3. In addition to seismic and wind loads, consideration shall be given to other loads, including but not limited to dead, live, snow, etc., as applicable. All restraint design shall be based on the "worst case" combination of the applicable loads as prescribed by the referenced code and standards.

4. Consideration shall also be given to thermal stresses and expansion. Where thermal expansion applies, seismic restraint design shall be in accordance with the requirements of ASME B31.1 in addition to ASCE 7.

1.6 SUBMITTALS

Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.

Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation and seismic restraint.

Vibration Isolation: submit the following, at a minimum, as applicable.

1. Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.

2. Detailed drawings showing equipment, isolator bases and isolator spacing.

3. Descriptive data or cut sheets for each type of isolation mounting, including:

    a. Dimensional data

    b. Materials and finish

    c. Rated loads

    d. Rated deflection

    e. Isolator free and operating heights

    f. Detailed installations instructions

Seismic Restraint: submit the following, at a minimum, as applicable.

4. Catalog cut or data sheets on specific restraints detailing compliance with the project drawings and specifications.

5. Detailed schedules of components, showing seismic restraints by referencing numbered descriptive drawings.

6. Description, layout and location of items to be restrained with anchorage or brace points noted and dimensioned.

7. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, fasteners, bolts, welds etc. clearly identified and specified.

8. Numerical value of design seismic restraint loads, or controlling loads if different than load combinations with seismic, with all supporting calculations.

9. Detailed installation instructions for seismic restraints.

10. Acceptable attachment methods of seismic restraints to structural members.

11. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.

12. Details for housekeeping pads for base-mounted equipment, including reinforcing and doweling requirements to the building structure.

13. Documentation verifying seismic prequalification for anchors in concrete per ACI 318 Appendix D.

14. Additional information as required to substantiate adequate design and installation of seismic restraints.

15. Manufacturer's Seismic Certificate of Compliance: Each manufacturer of a Designated Seismic System (with a Component Importance Factor, Ip = 1.5) shall submit a ***Certificate of Compliance*** for review and acceptance by the design professional in responsible charge and the authority having jurisdiction, prior to installation.

PART 2 - PRODUCTS

2.1 GENERAL

All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

Refer to the "Selection Guide" table in Section 4 to correlate the specification references listed below with the appropriate components.

2.2 MANUFACTURERS

Isolators and seismic restraints shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators and seismic restraint systems listed in the following sections are as manufactured by Gripple and California Dynamics.

1. Gripple
2. California Dynamics
3. The VMC Group
4. Mason Industries
5. Kinetics Noise Control
6. Cooper B-Line
7. CADDY
8. Hilti
9. Twin City Hose
10. ASC Equipment

2.3 VIBRATION ISOLATION

Specification V-1 (Pad Type Elastomer Isolator): A pad type mounting consisting of two layers of ribbed elastomeric pads with a 1" sandwich pad in between. Where the equipment foot is less than 80 percent of the surface of the pad a load distribution plate must be added to the top of the pad. Pads shall be VT as manufactured by California Dynamics Corporation or approved equal.

Specification V-6 (Combination Spring/Elastomer Hanger Isolator): Hangers shall consist of rigid steel frames containing double deflection Neoprene element at the top and a steel spring and a Neoprene sleeve on bottom to position spring and prevent steel to steel contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc from side to side. Hangers shall be type HH30 as manufactured by California Dynamics Corporation or approved equal.

2.4 VIBRATION ISOLATION WITH SEISMIC RESTRAINT

Specification SV-2 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A welded housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be DLK as manufactured by California Dynamics Corporation or approved equal.

2.5 SEISMIC RESTRAINTS

Specification S-1 (Seismic Snubbers): All directional seismic restraints shall consist of interlocking steel members. Neoprene shall have a minimum thickness of ¼". Incorporate a minimum air gap of 1/8", and a maximum air gap of ¼" in the design, before contact is made between the rigid and resilient surfaces. Provide removable end plate to allow inspection of internal clearances. Restraints shall be type RL-A/ RL-C as manufactured by California Dynamics Corporation.

Specification S-2 (Seismic Cable Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Secure cable to structure and braced component through bracket or stake eye specifically designed to meet or exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASTM A1023 or EN-12385 or other approved equivalent. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Gripple Inc. GS series.

Specification S-3 (Rigid Brace Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of steel angles or channels. Rigid braces and connecting elements shall be sized for the applied seismic loads. Connecting elements shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment. Restraint shall be CADDY Strut Seismic Hinge.

PART 3 - EXECUTION

3.1 EXAMINATION

All areas that will receive components requiring vibration isolation and seismic restraint shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

3.2 INSTALLATION, GENERAL

Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.

Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

3.3 SEISMIC RELATIVE DISPLACEMENTS

Provide joints with sufficient flexibility capable of accommodating seismic relative displacements as follows.

1. Vertical conduit, cable tray, bus duct, etc. that pass between floors of the building,
2. Systems that pass through a building seismic or expansion joint,
3. Rigidly supported components that connect to other components.

3.4 POST-INSTALLED ANCHORS:

Install all anchors in accordance with the manufacturer's written instructions for seismic applications.

Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

3.5 HOUSEKEEPING PADS

Housekeeping pads shall be designed by the seismic restraint vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated seismic or wind forces. Frictional resistance due to the effects of gravity shall be neglected.

The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.

1. If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

2. If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

3.6 ELECTRICAL COMPONENTS

Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.

1. Design equipment anchorage to resist seismic design force in any direction.

2. Design vibration and seismic controls for equipment to include base and isolator requirements.

3. Provide flexible connections between equipment and interconnected conduit to account for seismic relative displacements.

4. Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.

5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.

6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.

7. Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.

Suspended electrical equipment

8. Design support and bracing to resist seismic design force in any direction.

9. Provide flexible connections between equipment and interconnected conduit to account for seismic relative displacements.

10. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.

Wall-mounted electrical equipment

11. Design attachments to resist seismic design force in any direction.

12. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

Conduit/Cable Tray/Bus Duct

13. Provide supports, braces and anchors to resist gravity and seismic design forces.

14. Design risers to accommodate interstory drift. Provide flexible connections wherever relative differential movements could damage distributed system in an earthquake.

15. Brace every run (5’ or more in length) with two transverse and one longitudinal bracing locations. Provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center.

16. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.

17. Where distributed system is explicitly exempt from seismic bracing requirements,

    a. Install such that swinging of the system will not cause damaging impact with adjacent components. This will be considered satisfied if there is horizontal clear distance of at least 2/3 the hanger length between subject components.

    b. Provide flexible connections between system and connected equipment.

3.7 QUALITY CONTROL

Do not install vibration isolators or seismic restraints until submittals have been reviewed and approved by the registered design professional in responsible charge.

Verify that multiple systems installed in the same vicinity can be installed without conflict.

Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.

No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.

Where Special Inspections are required per Sections 1704 and 1705 of the 2018 International Building Code, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE

ELECTRICAL EQUIPMENT

EQUIPMENT TAG	Ip (Note 3, 4)	ISOLATION SPEC.	ISOLATION DEFL.	SEISMIC REST. SPEC. (NOTE 1)
TRANSFORMERS (Base Mounted)	1.0	SPEC V-1	.15”	NOTE 2
TRANSFORMERS (Suspended)	1.0	SPEC V-6	1.5”	SPEC S-2
SWITCHGEAR	1.0	N/A	N/A	NOTE 2
SWITCHBOARD	1.0	N/A	N/A	NOTE 2
LIGHTING (NON-EMERGENCY)	1.0	N/A	N/A	NOTE 5
LIGHITNG (EMERGENCY)	1.5	N/A	N/A	NOTE 5
CONDUIT/CABLE TRAY/BUS DUCT	1.0	N/A	N/A	SPEC S-2

NOTES

1. Seismic restraint to be provided only where required in the project drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. All components in a Risk Category IV building are assigned a Component Importance Factor I_p equal to 1.5.
4. All components included as part of a Life Safety System must be assigned a Component Importance Factor I_p equal to 1.5.
5. Means of support to follow section 410.16 of NEC. ASCE 7-16 Section 13.5.6.2 references ASTM C635, C636, and E580 for the requirements for the construction of ceilings for seismic applications and includes specific requirements for electrical fixtures included in an acoustical ceiling.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Tapes and stencils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

C. Comply with ANSI Z535.4 for safety signs and labels.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 240-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.

4. Colors for 480/277-V Circuits:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

B. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

C. Equipment Identification Labels:

1. Black letters on a white field.

2.3 TAPES AND STENCILS

A. Underground-Line Warning Tape:
1. Tape:

    a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

    a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
    c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

2.4 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:

    a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
    b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
    c. Engraved legend with black letters on white face.

d. Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

3.2 IDENTIFICATION SCHEDULE

A. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

SECTION 260573 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

A. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form:

a. Arc-flash study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data

F. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.

7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform Short-Circuit study prior to starting Arc-Flash Hazard Analysis.

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain data necessary for conduct of arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.

3.4 LABELING

A. Apply one arc-flash label on front cover of each section of equipment for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below must have arc-flash label applied to it:

1. Medium-voltage switchgear.
2. Medium-voltage switches.
3. Medium voltage transformers
4. Low-voltage switchgear
5. Switchboards.
6. Panelboards.
7. Motor-control centers.
8. Low voltage transformers.
9. Safety switches.
10. Control panels.

C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Coils: Continuous windings except for taps.

1. Coil Material: Aluminum.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Bolted.

F. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70.

B. Cores: One leg per phase.

C. Indoor Enclosure: Ventilated.

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.

D. Outdoor Enclosure: Ventilated.

1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
2. Wiring Compartment: Sized for conduit entry and wiring installation.

E. Taps for Transformers 3 kVA and Smaller: None.

F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

H. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

K. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Construct concrete bases according to Concrete Specifications and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Secure transformer to concrete base according to manufacturer's written instructions.

D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Provide grounding connection for secondary to building ground system. Sizer grounding conductor per NEC.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, and grounding.
    c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    d. Verify the unit is clean.
    e. Perform specific inspections and mechanical tests recommended by manufacturer.
    f. Verify that as-left tap connections are as specified.
    g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:
    a. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

B. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.2 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Detail utility company's metering provisions with indication of approval by utility company.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include schematic and wiring diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

1.5 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

G. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

H. Nominal System Voltage: Refer to Drawings.

I. Main-Bus Continuous: Refer to Drawings.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

J. Indoor Enclosures: Steel, NEMA 250, Type 1.

K. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.

L. Space Heaters for Outdoor Installations: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

M. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

N. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

O. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
1. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
2. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
3. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

P. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
3. Tin-plated aluminum feeder circuit-breaker line connections.
4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.

7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.

C. Features and Accessories:
1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
2. Indicator light display for protection status.
3. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
4. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V AND 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V AND 1200 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V AND 1000 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 1000 V.
3. Line to Line: 1000 V.

G. SCCR: Equal or greater than the available short circuit current at the point on the system where installed.

H. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. All circuit breakers 1200A and higher shall be equipped with energy-reducing maintenance switching with local status in order to provide arc energy reduction per NEC 240.87.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the field-adjustable settings as indicated on the drawings.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Shunt Trip (as required): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

C. Insulated-Case Circuit Breaker (ICCB): sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and field-adjustable settings as indicated on the drawings:

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

2.5 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Install switchboards and accessories according to NEMA PB 2.1.

C. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in concrete specifications.

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Acceptance Testing:

a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush or Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wash-Down Areas: NEMA 250, Type 4X,.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

G. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2 as shown on drawings.

2.3 POWER PANELBOARDS

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Panelboards: NEMA PB 1, distribution type.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. All circuit breakers 1200A and higher shall be equipped with energy-reducing maintenance switching with local status in order to provide arc energy reduction per NEC 240.87

C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. Subfeed Circuit Breakers: Vertically mounted.
7. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NEMA PB 1.1.

C. Mount panelboard cabinet plumb and rigid without distortion of box.

D. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

F. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

G. Install filler plates in unused spaces.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. Toggle switches.
5. Wall plates.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

2. All receptacle devices in childcare facilities and all education facilities shall be tamper-resistant. All devices shall meet requirements of NEC 406.12.

2.3 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 12 V, 2.0 A, USB Type A and 20V, 3A, Type C; Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.

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

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

3. USB Receptacles: Dual, Type A and Type C.
4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.4 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

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

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

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

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Pass & Seymour/Legrand (Pass & Seymour).

D. Locations:

1. Install GFCI devices at all locations required by NEC Article 210.8, whether or not indicated on plans. These locations include:
   a. Dwelling Units:
      1) Bathrooms
      2) Garages and similar accessory buildings
      3) Outdoors
      4) Crawl Spaces
      5) Basements
      6) Kitchens where receptacles are installed to serve countertop surfaces
      7) Within 6’ of the top inside edge of the bowl of a sink
      8) Boathouses
      9) Within 6’ of bathtubs or shower stalls
      10) Laundry areas
      11) Indoor damp and wet locations
   b. Other than dwelling units:
      1) Bathrooms
      2) Kitchens or areas with sink and permanent provisions for food prep or cooking
      3) Rooftops
      4) Outdoors
      5) Within 6’ of the top inside edge of the bowl of a sink
      6) Indoor damp and wet locations

7) Locker rooms with associated showering facilities
8) Garages, accessory buidlngs, service bays, and similar areas
9) Crawl Spaces
10) Unfinished areas of basements
11) Laundry areas
12) Within 6’ of bathtubs or shower stalls

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

2. Two Pole:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

3. Three Way:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Type 302/304 stainless steel, brushed satin finish, minmum 20-gauge thick.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof While-In-Use Cover Plates: NEMA 250, complying with Type 3R, weather-proof while in use, die-cast aluminum with lockable cover.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color: Stainless steel

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1 unless otherwise indicated.

B. ARC-FAULT CIRCUIT-INTERRUPTER PROTECTION:
1. Provide arc-fault circuit interrupter protection at all locations required per 210.12 whether indicated on plans or not.
2. This includes any circuits serving outlets or devices in
   a. dwelling units
   b. dormitory units and their associated bedrooms, living rooms, hallways, closets, bathrooms, and similar rooms
   c. guest rooms, guest suites, and patient sleeping rooms
   d. For purposes of this requirement, all circuits serving outlets in bunk rooms or other associated sleeping rooms shall have AFCI protection

C. Mount Devices at the heights listed below unless listed specifically on drawings:
1. Exterior Outlet Boxes: 24” Above Finished Grade
2. Interior Outlet Boxes: 18” Above Finished Floor (AFF)
3. Device Boxes for Switches, Fire Alarm Pull Stations, Intercom Call Stations, etc.: 48” AFF
4. Outlet Boxes for Wall-mounted clocks: 96” AFF or 6” below the ceiling when not possible. Center clock outlets located above doors between the ceiling and the top of the door trip.
5. Above Counter Outlet and Junction Boxes: 8” above countertop surfaces or at backsplash level.
6. Coordinate mounting height of specific-use receptacles with equipment and finishes.
7. Coordinate mounting height to match mechanical devices (thermostats).

D. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

E. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

F. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

J. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Perform the following tests and inspections:

1. Tests for Convenience Receptacles:

a. Line Voltage: Acceptable range is 105 to 132 V.
b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
c. Ground Impedance: Values of up to 2 ohms are acceptable.
d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
e. Using the test plug, verify that the device and its outlet box are securely mounted.
f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Horsepower Rated Toggle Disconnect Switch
6. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories (as required per plans):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.

3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories (as required per plans):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

2.4 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. Square D; by Schneider Electric.
    a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated or series rated as indicated on the Drawings. combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 167 deg F rated wire.

G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the field-adjustable settings as indicated on drawings.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

2.5 Horsepower Rated, Toggle Switch Type Disconnect Switch

A. Toggle type disconnect switches shall be manufactured of thermoplastic materials with screw-type terminals. The switches shall be rated 600 VAC and 20A at 600 VAC.

B. Toggle type disconnect switches shall be similar to a manual non-reversing starter without overloads and shall be 3 Pole, capable of “on-off” control of a 10 horsepower motor at 460 VAC.

C. Enclosure shall be provided with lock off provisions.

D. NEMA 4 enclosures shall be die-cast zinc.

E. Switches shall be as manufactured by the Square D Co.; Siemens Electrical Products; Cutler-Hammer or equal.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure rating shall be equal to or greater than the fuse or circuit breaker rating.

C. Enclosure Finish: The enclosure shall be as indicated on drawings.

D. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

E. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

F. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

G. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.2 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices. Fuse Ratings for mechanical equipment or transformers shall match the rating of the upstream circuit breaker feeding the equipment.

F. Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.
    a. Label on each disconnect means shall include both purpose and source, such as “AHU-1. Fed from Panel MDP”

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, grounding, and clearances.
    c. Verify that the unit is clean.
    d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    e. Verify that fuse sizes and types match the Specifications and Drawings.
    f. Verify that each fuse has adequate mechanical support and contact integrity.
    g. Inspect bolted electrical connections for high resistance using one of the two following methods:

        1) Use a low-resistance ohmmeter.

            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

    h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    i. Verify correct phase barrier installation.
    j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

    1) Use a low-resistance ohmmeter.

        a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

    2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

        a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION 262816

SECTION 265119 - GENERAL LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.
13. Exit and Emergency Lighting

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Product Schedule: Refer to light fixture schedule on the plans.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Product Schedule: Refer to light fixture schedule on the plans.

B. Fixture Schedule included in plans is basis of design. Provide fixtures as specified to match campus preferred lighting.

C. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers, and Globes:

1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.3 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Exit Signs: Exit signs shall be roughed-in to be centered over or above door they are indicating as exit, or in hallways they are installed in. Exit signs in hallways shall be aligned with other lights in the area. Exit signs observed to be installed and not centered with doors or hallways shall be relocated at no additional cost.

F. Flush-Mounted Luminaire Support: Secured to outlet box.

G. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

H. Ceiling-Mounted Luminaire Support:

1. Ceiling mount per manufacturer’s recommendations.

I. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod, or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

J. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

L. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16553 "Identification for Electrical Systems."

M. Where 0-10V dimming is indicated in controls requirements, contractor shall furnish and install 0-10V dimming cabling to each fixture to accomplish dimming control.

N. Where a light fixture is indicated via plan or fixture schedule to be an emergency fixture, contractor shall route unswitched power to light fixture in addition to normal circuit such that fixture will sense an outage and automatically illuminate in an emergency situation.

O. All site lighting pole lights shall be installed to maintain 36” clear from back of curb to edge of concrete pole-base. Field verify final locations with final civil plan and edge of parking lots.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. 19-inch wall-mounted equipment cabinets.
3. Power strips.
4. Grounding.
5. Labeling.

1.2 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Data: Certificates, from manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as Technician to perform on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. UL listed.

C. RoHS compliant.

D. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.2 19-INCH EQUIPMENT RACKS

A. Description: Four- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.

B. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Extruded aluminum.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black.

C. Floor-Mounted Racks:

1. Per ASU-ITS Campus Standards

D. Cable Management:

1. Per ASU-ITS Campus Standards

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with detachable flanges.
3. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. Front-facing receptacles.
5. LED indicator lights for power and protection status.
6. LED indicator lights for reverse polarity and open outlet ground.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Cord connected with 15-foot line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Surge Protection: UL 1449, Type 3.

    a. Maximum Surge Current, Line to Neutral: 27 kA.
    b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
    c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and 500 V for neutral to ground.

2.4 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.

4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.

C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.

1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."

END OF SECTION 271116

SECTION 271323--COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-mode, optical fiber cable per ASU-ITS Campus Standards.

2. Optical fiber cable connecting hardware, patch panels, and cross-connects.

3. Cabling identification products.

1.2 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.

3. Wiring diagrams to show typical wiring schematics including the following:

a. Telecommunications rooms plans and elevations.

b. Telecommunications pathways.

c. Telecommunications system access points.

d. Telecommunications grounding system

e. Cross-connects.

f. Patch panels.

g. Patch cords.

4. Cross-connects and patch panels.

C. Optical fiber cable testing plan.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Product Certificates: For each type of product.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of[Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as a Technician.

1.7 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 SINGLE-MODE, OPTICAL FIBER CABLE (

A. Description: Refer to ASU-ITS Campus Standards for cable requirements and part numbers.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Description: Refer to ASU-ITS Campus Standards for cable requirements and part numbers.

B. Cross-Connects and Patch Panels: Refer to ASU-ITS Campus Standards for cable requirements and part numbers.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Connector Type: Refer to ASU-ITS Campus Standards for connector requirements and part numbers.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

3. Marked to indicate transmission performance.

4. Designed to snap-in to a patch panel or faceplate.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in un-

finished spaces.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. Comply with ASU-ITS Campus Standards

C. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.

2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."

3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Twisted pair cable hardware, including plugs and jacks.
   3. Cable management system.
   4. Grounding provisions for twisted pair cable.

1.2 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

   1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
   2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
   3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

D. Refer to ASU-ITS Campus Standards. All network cabling material and installation shall comply with campus standards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.
   1. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

C. Twisted pair cable testing plan.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.6 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Manufacturers: Refer to ASU-ITS Campus Standards for cable requirements and part numbers.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of cabling being connected, spliced, and/or terminated.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

D. Patch Panel: Refer to ASU-ITS Campus Standards for patch panel requirements and part numbers.

E. Jacks and Jack Assemblies:

1. Refer to ASU-ITS Campus Standards for jack requirements and part numbers.

F. Faceplate:

1. Refer to ASU-ITS Campus Standards for faceplate requirements and part numbers.

G. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 GROUNDING

A. Comply with TIA-607-B.

PART 3 - EXECUTION

3.1 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. Refer to ASU-ITS Campus Standards for all campus installation requirements.

C. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

D. Wiring that is not installed in raceways and cable trays shall be installed in J-hooks mounted to walls above accessible ceiling. Maximum j-hook spacing shall be 5’. Cabling homeruns above accessible ceiling in corridors shall not be laid on ceiling grid.

E. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

F. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

11. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

3.2 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.3 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Equipment grounding conductors.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection. Provide test reports for owner and engineer’s review upon completion of testing.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION 271513

SECTION 283113 – ADDRESSABLE FIRE ALARM SYSTEM WITH VOICE EVACUATION

PART 1 GENERAL

1.01. WORK INCLUDED:

A. The work included in Division 26 is the installation of the electrical systems as indicated on the drawings and required by the specifications. All provisions of the General Conditions, Special Conditions, and Instructions to Bidders apply to this work.

1.02. SHOP DRAWINGS: The successful contractor shall provide electronic shop drawings immediately after award of the contract. Shop drawings shall be assumed to be "as specified" unless specifically identified as varying from contract requirements. Any variations from "as specified" status shall be specifically identified and their substitution approval status (as approved by B., Substitutions) shall be documented. Shop drawings shall include:

A. Provide equipment cut sheets and a project Bill of Material

B. Provide job specific riser diagram indicating, as a minimum, location of panels, initiating and signaling devices, wire requirements, and box sizes.

C. Provide system power and load calcualation documentation report. Show complete battery calculations for the system by panel or transponder. Show load calculations and voltage drop calculations for all notification appliance circuits and signaling line circuits.

D. Provide copy of Nicet Level III or IV certification

1.03. DRAWINGS AND SPECIFICATIONS: The contractor shall examine the drawings and specifications to ensure that they are familiar with the requirements of the specification as they apply to the intstallation site and the owner's requirements.

1.04. CODE COMPLIANCE: The contractor is responsible for complying with the proper state and local code authority's plan review and approval process. Copies of code approval submissions and approvals shall be provided to the engineer. The contractor is responsible for the cost of this process.

PART 2 EQUIPMENT

2.01. GENERAL

A. Fire Alarm Control Panel

B. System Front Panel Operation and Capabilities

C. Voice Evacuation Control

D. Addressable Devices

E. Peripheral Devices

F. Walktest Group Requirements

G. Project Specific Requirements

1. The system specified will constitute the building Life Safety System. The sytem will provide necessary fire and smoke detection as well as providing automatic and manual voice evacuation capability.

2. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications and all circuits must be marked in accordance with NEC article 760-23.

3. All control equipment must have transient protection to comply with UL864 requirements.

4. The control panel shall receive 120 VAC power (as noted on the plans) via a dedicated circuit.

5. The system shall be provided with sufficient standby capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four (24) hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby power source upon power failure. All battery charging and recharging operations shall be automatic.

6. All external circuits requiring system operating power shall be 24VDC and shall be individually fused at the control panel.

2.02. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Simplex. Integreate new Simplex system into campus fire alarm network and interface with Computrols system

2.03. FIRE ALARM CONTROL PANEL

A. Control Panel construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.

1. Fire alarm panel shall have system function bypass buttons programmed into per ASU campus standards.

2. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This

audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.

B. Primary Keys, LED's and LCD Display

1. The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.

2. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status Information. A cursor shall be visible when entering information.

3. The LCD display shall have the capability of annunciating up to 2500 points.

C. System Point Capacity

1. Point capacity shall support any combination of addressable monitor or control points, e.g., all points can be monitor, all points can be control, or any combination of monitor and control.

2.04. SYSTEM PANEL OPERATION AND CAPABILITIES

A. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch shall be as follows:

1. A digitized emergency message shall be transmitted to all speaker zones activated for that alarm. The alarm message shall be preceded by a chime tone and then repeated three times This message sequence shall repeat at one minute intervals and a temporal chime pattern shall sound during the time between messages.

2. All visible alarm indicating appliances shall flash continuously until the the system is reset. To reduce the risk of seizure induced by an individual viewing more than 2 strobes flashing asynchronously the fire alarm strobes shall be synchronized. The strobes shall flash at the rate of once per second and all strobes at the same instant. This shall be accomplished in a UL listed manner.

3. Alarm indicating appliances shall operate selectively by area in a programmed sequence. Exact manner of operation will be detailed by the engineer prior to installation.

4. Any subsequent zone alarm shall reactivate the alarm indicating appliances.

B. The fire alarm control panel shall control and communicate with remote power supplies through a 4-wire communication backbone. Each remote power supply shall provide 8 amps of power to be used for Audible and Visual circuits. Each remote power supply shall have battery backup for 24hr standby with 15 minutes of alarm.

C. The alarm shall be displayed on an 80 character LCD display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel until the alarm has been

acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel. The LCD display shall show the new alarm information.

D. The system shall have the capability to monitor the smoke detection operation of the the system sensors to provide "two stage" operation. The panel shall be capable to operate in the following mode if desired: When an individual smoke sensor senses smoke at a .2%/.5% or 1% obscuration level (desired level will be indicated for each device by the owner) a supervisory notice shall be generated. This condition shall cause a message to be shown on the control panel indicating the need for investigation of this condition. This operation is designed to provide staff with the opportunity to investigate situations where very low amounts of smoke are generated, e.g., a smoldering fire condition that typically takes a long time to develop. When the sensor level reaches its programmed alarm level, 2.5% obcuration typical, the normal system alarm sequence will take place.

E. The system shall support the same multi-stage operation when used with heat sensors, e.g., a software selectable level for supervisory notification and a higher, alarm causing, temperature level.

F. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch for the annunciation and acknowledgement of sprinkler supervisory functions (OS&Y, PIV, etc.).

G. History Logging

1. The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.

H. Audible Walktest

1. The system shall be capable of being tested by one person. When in the walk test mode the system shall announce the zone being tested or the digital address of the device being tested as each device or zone is activated. System shall announce that testing is completed when system is returned to normal.

I. Silent Walktest with History Logging

1. While in this testing mode the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm.

J. Visual Walktest with History Logging

1. While in a testing mode the activation of any initiating device will cause the system visual devices to flash in response to that activation. Visuals shall flash twice each time a device is activated. A separate visual indication shall be provided for activation of trouble conditions or supervisory conditions.

2.05. ONE-WAY VOICE COMMUNICATION

A. Provide one-way voice communication and tone generating capabilities.

B. A central audio control module shall be provided for the necessary alarm message/tone generation, main and remote microphone connections, music inputs and mixer/pre-amplifier circuits. Continuous supervision shall be provided. Audio outputs shall have individual gain control.

C. A hand-held, push-to-talk microphone shall be provided recessed within a protective panel-mounted enclosure. The microphone shall be a dynamic communication type with a frequency range of 200 Hz to 4000 Hz and shall be equipped with a self-winding five foot coiled cable. An LED indicator shall be provided to indicate microphone push-to-talk button has been pressed and speaker circuits are ready for transmission. Microphone shall be supervised from disconnection.

D. An audio control switch module shall be furnished to provide manual control of the audio functions. These switches and associated LED indicators shall be supervised from disarrangement or failure.

E. Audio power amplifiers shall be furnished with self-contained filtered 24VDC power supply, transformer and, amplifier monitor circuits. Amplifiers shall provide a 25 VRMS or 70 VRMS output with a frequency response of 120Hz to 12,000Hz. Provide a sufficient quantity of amplifiers to operate, at rated wattage, all system speakers simultaneously plus twenty (20) percent spare capacity. For Sanctuary, Gymnasium and Pool area provide High DB Speakers rated at 116 DBA at 10 feet.

F. Tones. Digitized tones for alarm or auxiliary requirements shall be available. Tone requirements are as follows.

1. The Slow Whoop shall be a slowly ascending tone from 200 to 830 HZ in 2.5 seconds.

2. The Wail shall ascend and descend from 600 to 940 HZ.

3. The Beep shall be a 470 HZ tone. The time duration shall be 0.7 seconds on and 0.7 seconds off.

4. The Horn shall be a continuous 470 HZ tone.

5. The Stutter shall be a 470 HZ tone which is on for 100 milliseconds and off for 100 milliseconds.

6. The Chime shall be a 700 HZ tone with a 1.5 second delay time.

7. The Coded Horn shall be a 470 HZ tone designed specifically for use on a coded system.

8. The Hi/Lo shall be a free running tone with a high frequency of 544 HZ and a low frequency of 440 HZ. The "on time" (Hi) shall be 100 milliseconds while the "off time" (Lo) is 400 milliseconds.

G. A pre-recorded digitized voice message capability shall be provided for automatic transmission to building occupants during alarm conditions. Multiple messages specific to the condition and the area of the building shall be provided.

H. Message requirements for this project are detailed in 2.7, Project Specific Requirements. All clear messages shall be for each condition, e.g., "all clear fire alarm condition", "all clear severe weather condition"; blanket all clear statements are not acceptable.

I. Provide the alarm, severe weather, and all clear messages in English. Provide these messages in either a male or a female voice, or both, as the owner directs.

J. Messages shall be factory digitized from transcripts approved by the engineer. Manufacturer shall maintain digital archival records of the messages as an owner backup copy.

K. The message player shall not rely on a tape or other mechanical means of generating the system messages. The message player must be capable of transmitting a custom digital message of up to four minutes in length or a four minute long “string” of digitized tones, words and phrases that may be software “spliced” to create customized messages.

2.06. ADDRESSABLE DEVICE NETWORK

A. Communication with addressable devices. The system must provide communication with initiating and control devices individually. All of these devices will be individually annunciated at the control panel.

B. All addressable devices shall have the capability of being disabled or enabled individually.

C. Up to 250 addressable devices may be multidropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.

D. Format

1. The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.

E. Device Replacement

1. Both smoke and heat sensors must be able to be changed by the owner with addressing by binary dip switches or mapping to identify the devices.

F. Addressable Device Types

G. General Requirements

1. The system control panel, must be capable of communicating with the types of addressable devices specified below. Addressable devices will be located as shown on the drawings and as required to meet code and all AHJ requirements. The location of addressable devices will be selected along with conventional devices to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.

2. Addressable Detector Bases.

All addressable smoke and heat detector heads as specified below will be pluggable into their bases. The base will contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Different detector heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel.

3. Photoelectric Detector Head

   a. The Photoelectric type detector shall be a plug-in unit which mounts to a twist-lock base, and shall be UL approved.

   b. The detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry.

   c. The detector shall fit into a base that is common with both the heat detector and ionization type detector and shall be compatible with other addressable detectors, addressable manual stations, and addressable Zone Adapter Modules on the same circuit.

   d. There shall be no limit to the number of detectors or Zone Adapter Modules which may be activated or "in alarm" simultaneously.

4. Addressable Analog Thermal Detector Head

   a. Thermal detector heads must be analog devices. They will be a programmable for fixed and/or rate of rise operation in accordance with the engineer's instructions.

5. Addressable Pull Stations

   a. Provide addressable, push double action pull stations.

   b. Pull stations will be key reset, common keyed. Pull station locks and control panel locks shall be keyed alike.

   c. Provide protective wire guards for Gymnasium devices.

6. Addressable Photoelectric Duct Detector

   a. The detector shall be a non polarized 24VDC type which is compatible with the Fire Alarm Panel and obtains its operating power from the supervisory current in the fire alarm detection loop.

   b. Provide with appropriate length sampling tubes.

   c. Provide unit with programmable relay for HVAC interface.

   d. For concealed units provide a remote LED/Test remote device located below the ceiling level directly beneath the unit being monitored.

7. Individual Addressable Module

a. Zone Adapter Modules shall be used for monitoring of waterflow, valve tamper, Halon Control Panels, non-addressable detectors, and for control functions for elevators, etc.

8. Addressable Device Supervision

a. All devices shall be supervised for trouble conditions. The system control panel will be capable of displaying the type of trouble condition (open, short, device missing/failed).

b. Should a device fail, it will not hinder the operation of other system devices.

2.07. PERIPHERAL DEVICES

A. Fire Alarm Strobes

1. Where indicated on the drawings provide visible notification appliances. Units shall utilize a polycarbonate lens design incorporating a multi-surface relector providing symmetrical light output in key axis directions. Lens assembly shall lock on to the base to provide an impact and vandal resistant assembly. Strobe shall be UL listed to Standard 1971 and comply with the requirements of the Americans with Disabilities Act. Units shall be available in red or white style.

2. All visible alarm indicating appliances (whether standalone or mounted to an AV) shall flash continuously until the system is silenced or reset as directed by the owner. To reduce the risk of seizure induced by an individual viewing multiple strobes flashing asynchronously the fire alarm strobes shall be synchronized. The strobes shall flash at the rate of once per second and all strobes on each individual signal circuit shall flash at the same instant. This shall be accomplished in a UL listed manner.

3. Visible alarm indicating appliances shall accept a coded input signal, e.g., it shall be possible through software to cause the strobes to flash in a temporal , march time, or other selected pattern.

B. Fire Alarm Speakers (High Ambient Speakers)

1. Where indicated on the drawings provide high ambient fire alarm speaker.

2. Speaker shall be of die-cast contstruction providing wattage tap15 watts.

3. Speaker shall be capable of 116 dBA output at 10' when driven by a 1000 hz signal. Units shall be UL listed to Standard 1480.

4. Speaker shall be capable of either 25VRMS or 70VRMS inputs.

C. Fire Alarm Speaker/Strobes – (ceiling, flush)

1. Where indicated on the drawings provide fire alarm speaker/strobe units.

2. These combination units shall be UL listed to Standards 1971 and 1480 and feature wattage taps of 1/4, 1/2, 1, and 2 watts.

3. Speaker shall be capable of a minimum 85 dBA output at 10' when driven with a 1000 hz signal.

4. The unit shall be available in red or off-white. Utilize Red or White for this project.

5. All other areas not considered assembly shall utilize combination Horn/Strobe units and shall meet requirements of visual strobe units in item A.

D. Fire Alarm Speakers (wall mount)

1. Where indicated on the drawings provide fire alarm wall mounted speaker units.

2. These units shall be UL listed to Standards 1971 and 1480 and feature wattage taps of 1/4, 1/2, 1, and 2 watts.

3. Speaker shall be capable of a minimum 85 dBA output at 10' when driven with a 1000 hz signal.

2.08. WALKTEST GROUP REQUIREMENTS

A. A. In order to facilitate testing of various areas and subsystems within the building, Walktest groups shall be provided. Walktest groups are software partitions within the fire alarm control software that allow testing of portions of the fire alarm system without a loss of protection in those areas not being tested.

2.09. REMOTE ANNUNCIATOR

A. Where indicated on the drawings provide a serial LCD remote annuciator. Remote annuciator shall have an 80 character display for ease of device location.

B. Remote annuciator shall have power on led, system trouble led and sounder.

C. Annuciator shall have capabilities of remote signal silence and remote reset, but shall be key activated, to control use of these functions. Remote annunciator shall have capability of 4 remote key commands, which could be used for remote bypass of system functions. These remote command keys shall also be key activated.

PART 3 EXECUTION

3.01. INSTALLATION

A. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B. Upon completion, the contractor shall so certify in writing to the owner and general contractor.

B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.

C. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.

D. The manufacturer's authorized representative shall provide onsite supervision of installation.

3.02. TESTING

A. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the contractor in the presence of the owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.

3.03. WARRANTY

A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H guidelines.

END OF SECTION 283113

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities, abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion and sedimentation control measures.
2. Section 015639 "Temporary Tree and Plant Protection"
3. Section 0157113 "Temporary Erosion and Sediment Control"
4. Section 312000 "Earth Moving"

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 MATERIAL OWNERSHIP

A. Except for 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.

1.4 FIELD 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 trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store

on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

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. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. 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. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
2. Use only hand methods or air spade 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.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings, of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 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.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade,pavements, turf and grasses, and, plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks, pavements.
6. Subbase course and base course for asphalt paving.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 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 for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, will 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 fabricated 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports:

1.5 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, Groups A-1, A-2-4, A-2-5, and A according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, Groups A-2-6, A-2-7, A-4, A-5, A-6, and A according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

1. Arkansas Highway and Transportation Department Class 7 Aggregate Base Course (ABC)

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washedcrushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils 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 deep; colored as follows:

1. To comply with local practice or requirements of authorities having jurisdiciton.

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 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.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. 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. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 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 higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms:

1. 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.

a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 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, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

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 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. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 0321313 "Concrete Pavement"."

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

a. 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.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape:

1. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 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.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

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.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches 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 D698, ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.13 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.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent

ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade 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.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 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. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. 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 D698, ASTM D1557.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

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. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by 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.

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.

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.

END OF SECTION

SECTION 312116 - TRENCHING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section Includes:

1. Excavating trenches for piped utilities.

B. Related Sections:

1. Section 312000 "Earth Moving" for backfilling and compaction of utility trenches.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D6938 - 10 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Section 013000 – Administrative Requirements: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable codes, and City of Jonesboro Ordinances.

1.6 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Arkansas.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Call “One Call”, the local utility information service at 811 not less than three (3) working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 of a cubic yard measured by volume. Remove larger material as specified in Section 312000 as rock excavation.

C. Perform excavation within 24 inches of existing utility service and in accordance with utility's requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe utilities.

H. Do not interfere with 45 degree bearing splay of foundations.

I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by notify Engineer, and request instructions.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with satisfactory fill material as defined in Section 312000, "Earth Moving" and compact to density equal to or greater than requirements for subsequent backfill material.

L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

M. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with satisfactory fill as directed by Engineer.

N. Remove excess subsoil not intended for reuse, from site.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of

excavation.

C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new,and,existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Refer to Drawings and Section 312000, "Earth Moving" for backfill procedure and materials for various pipe types.

D. Employ placement method that does not disturb or damage utilities in trench.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not leave more than 50 feet of trench open at end of working day.

G. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

3.7 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed. Basis of acceptance shall include but not be limited to compacted density performed as specified herein.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method) or ASTM D 6938.

B. If in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, Contractor shall perform additional compaction and testing, at his expense, until specified density is obtained.

3.8 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction dewatering.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 FIELD CONDITIONS

A. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide temporary grading to facilitate dewatering and control of surface water.

B. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 015000 "Temporary Facilities and Controls,",Section 311000 "Site Clearing," during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves,

appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.

C. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

END OF SECTION

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes temporary excavation support and protection systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.4 FIELD CONDITIONS

A. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.

PART 3 - EXECUTION

3.1 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.
2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.2 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.

1. Limit vertical offset of adjacent sheet piling to 60 inches.
2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.3 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.4 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work.

If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
2. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction, and abandon remainder.

END OF SECTION

SECTION 320523 - CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. 312000 "Earth Moving"

1.2 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Material certificates.

C. Material test reports.

D. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

A. 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."
2. Manufacturer shall provide concrete mix designs stamped and sealed by a licensed professional Engineer licensed in the State of Arkansas.

B. Testing Agency Qualifications: An independent agency, approved by Owner and

Engineer qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Testing Agency shall be managed by a licensed professional engineer licensed in the State of Arkansas.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

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

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage and provide a qualified independent testing agency to perform material evaluation tests and to sample and test concrete mixtures.

F. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 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.

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.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

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

1. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class I or Class II, as approved, zinc coated after fabrication and bending.
2. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

E. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.

F. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain or deformed steel, as approved.

G. 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.

2.3 CONCRETE MATERIALS

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

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

a. Fly Ash: ASTM C 618, Class F or C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.

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.

2.4 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.

2.5 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513,with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops

with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

C. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.7 CURING MATERIALS

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

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

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

D. Water: Potable.

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

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

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C

1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

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

2.9 CONCRETE MIXTURES

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. Concrete mixture designs shall be stamped and signed by a registered professional Engineer registered in the State of Arkansas.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Admixtures: Use admixtures with approval from Engineer and according to manufacturer's written instructions.

1. Use 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.

D. Proportion normal-weight concrete trail and pavement mixture as follows:

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 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.
4. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

E. Proportion normal-weight concrete bridge pier, abutment and structure mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 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.

4. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for1-inchnominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, 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 fours 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. Chamfer exterior corners and edges of permanently exposed concrete.

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.

3.3 VAPOR RETARDERS

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

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

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

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

3.5 JOINTS

A. Coordinate joint types, description, and location with Drawings. Joint types have been consolidated in this article for consistency rather than for strict sequence of installation.

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

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

D. 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. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch . Repeat grooving of contraction joints after applying surface finishes. Eliminate groover 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- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. 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.

F. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

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. Concrete shall not be placed on top of mud, standing water, ice, trash, debris or anything other than the specified subbase material.

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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

D. Cold-Weather Placement: Comply with ACI 306.1.

E. Hot-Weather Placement: Comply with ACI 301.

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.

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 one direction.

1. Apply scratch finish to surfaces indicated.

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.

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.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding,10-ft- long straightedge resting on two 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. 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, ramps, and elsewhere as indicated.

3.9 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. 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.
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.

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. Removal: 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.

3.10 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.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage and provide a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Sample concrete materials for slump, temperature and strength testing as required by ACI 301.

C. Provide one (1) set of concrete tests for each 50 cubic yards of material or fraction thereof.

D. Concrete test samples shall include four concrete cylinders for strength testing; one to be tested at 7 day, two to be tested at 28 day, and one spare to be tested at 56 days as required.

END OF SECTION

SECTION 321123 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Aggregate base course for Portland cement or asphalt concrete paving.

1.2 RELATED SECTIONS

A. Section 31 2000 "Earth Moving"

1.3 REFERENCES

A. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

B. ASTM D1557 – Test Methods for Moisture – Density Relations of Soils and Soil-Aggregate Mixtures Using 10lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

C. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

D. ASTM D6938 - 10 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Class 7 Base Course: Crushed stone base material with the following gradation:

1. Sieve (mm): 3” (75); Class 7 Percent Passing: N/A
2. Sieve (mm): 2” (50); Class 7 Percent Passing: N/A
3. Sieve (mm): 1-1/2” (37.5); Class 7 Percent Passing: 100
4. Sieve (mm): 1” (25.0); Class 7 Percent Passing: 60
5. Sieve (mm): 3/4” (19.0); Class 7 Percent Passing: 50
6. Sieve (mm): 3/8” (9.5); Class 7 Percent Passing: N/A
7. Sieve (mm): #4 (4.75); Class 7 Percent Passing: 25
8. Sieve (mm): #10 (2.00); Class 7 Percent Passing: N/A
9. Sieve (mm): #40 (0.425); Class 7 Percent Passing: 10
10. Sieve (mm): #200 (0.075); Class 7 Percent Passing: 3

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces

3.3 AGGREGATE PLACEMNT

A. Spread aggregate over prepared substrate to a maximum compacted thickness of 6 inches per lift.

B. Level and contour surfaces to elevations and gradients indicated.

C. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

D. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Flatness: Maximum variation of ¼ inch measured with 10 foot (3 m) straight edge.

B. Scheduled Compacted Thickness: Within ¼ inch.

C. Variation From Design Elevation: Within ½ inch.

3.5 FIELD QUALITY CONTROL

A. Compaction testing will be performed in accordance with ASTM D1557 and ASTM D6938, as indicated.

B. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

C. Frequency of Tests: One per lift per 2,500 square feet or as otherwise recommended by the Geotechnical Engineer.

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.

B. Related Sections:

1. Section 321123 "Aggregate Base Course" for aggregate subbase and base courses.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Design: For each job mix proposed for the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For each paving material, from manufacturer

1.4 QUALITY ASSURANCE

A. Allowable Tolerances:

1. Subgrade after fine grading:

a. Shall not vary more than 0.05 feet from plan elevation.

2. Aggregate base:

a. Shall not vary more than 0.05 feet from plan elevation.

3. Asphalt concrete hot mix binder course:

a. Shall not vary more than 0.04 feet from the plan elevation.
b. Shall not vary more than 0.04 feet from specified thickness.

4. Asphalt concrete hot mix wearing course:

a. Shall not vary more than 0.03 feet from the plan elevation.

b. Shall not vary more than 0.02 feet from specified thickness.
c. Shall not vary more than 0.015 feet from the edge of a 10 foot straight edge laid thereon parallel to or at right angles to the direction of paving.

5. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

a. Test and Design Mix Criteria:

1) Contractor, at his expense, shall employ the services of an independent testing laboratory to perform tests and design mixes. Materials and mix designs shall be approved at least 10 days before starting of construction

a) Aggregate tests (Aggregate Base Course):
b) The material to be used for the aggregate base course shall conform to Section 321123, Aggregate Base Course.
c) Preliminary job mix formula (Asphalt Concrete Hot Mix Surfacing):
d) A preliminary job mix formula shall be developed for the asphalt concrete hot mix surfacing material in accordance with AASHTO MP 2 or equal to AHTD requirements.
e) Resubmit a new job mix formula for OWNER'S approval if it becomes necessary to change the source of aggregates or when unsatisfactory results or other conditions warrant a change in mixture requirements.

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. Tack Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: AASHTO M 17, rock or slag dust, hydraulic cement, or other inert

material.

2.2 ASPHALT MATERIALS

A. Asphalt Bitumen for Binder Course and Surface Course: AASHTO M 320, PG 76

B. Bituminous Track Coat: CSS-1, CSS-1h, RC-70, MC-250, or OWNER approved equal.

2.3 MIXES

A. Hot-Mix Asphalt: Each mix design shall be prepared by laboratory analysis. Each mix design will establish a mix gradation for the aggregates (based on the weight of material passing specified screen sizes), an optimum asphalt binder content (expressed as a percentage of the total mix weight), an optimum laboratory mixing temperature, and an optimum laboratory compaction temperature. Optimum laboratory mixing and compaction temperatures shall be established based on temperature-viscosity curves of the asphalt binder to be used in the mix. The optimum asphalt content is the asphalt binder content at 4% Air Voids (AV) for PG 76 mixes and 4.5% Air Voids (AV) for PG 64 and PG 70 mixes. The mix design will be designed in accordance with the volumetric mix design procedures contained in AASHTO MP 2 and its referenced standards or equal to AHTD specified mix designs.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Fine grade and compact subgrade to the plan cross section. Compaction shall be as specified in Section 312000.

B. After compaction, cut-out soft spots and unstable areas in the subgrade and fill with granular fill as defined in Section 312000 and compact as specified in Section 312000.

3.2 AGGREGATE BASE

A. Where required, construct the aggregate base as shown on Drawings on the prepared subgrade as soon as possible after final shaping and compaction of the subgrade is completed.

B. Construction requirements shall be compacted to a density of at least 95 percent as defined by ASTM D1557 (Modified Proctor).

C. Density tests shall be taken as specified in Section 312000 and no bituminous layer shall be applied on the aggregate base course until it is approved by OWNER.

3.3 BITUMINOUS TACK COAT

A. Apply a bituminous tack coat to an existing bituminous surface if it has been dirtied by traffic or by other means just before constructing another bituminous course. The face

of all concrete surfaces to which the bituminous surface will come in contact with shall be sprayed or painted with tack oil.

3.4 BITUMINOUS BINDER COURSE

A. Construct a plant mixed bituminous binder course as shown on Drawings using a mechanical paver.

3.5 BITUMINOUS WEARING COURSE

A. Construct a plant mixed bituminous wearing course as shown on Drawings using a mechanical paver.

3.6 FIELD QUALITY CONTROLS

A. From time to time during progress of the work and/or upon completion of the work, OWNER may require that testing be performed to determine that materials provided for the work and its installation meets the specified requirements.

3.7 DEFECTIVE WORK

A. When tests and inspections of the aggregate base and/or bituminous work indicate non-compliance with the Specification, Contractor and OWNER shall mutually agree on the number and location of additional tests to define and/or verify the deficiency. If the average of the tests for a given area indicate non-compliance, the area is considered defective and Contractor shall:

1. Remove and replace defective work at no cost to OWNER;
2. Correct the work at no cost to OWNER in a manner acceptable to OWNER; or
3. Give OWNER a credit towards the Contract Price if said credit is acceptable to OWNER.

3.8 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.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
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 in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.9 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.

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, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 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. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and construct all exterior portland cement concrete as shown on Drawings and herein specified.

1. Work to be included under this Section shall consist of the following:

a. Driveways, fire access lanes, dumpster approach, sidewalks, and any concrete pavement specified on the drawings.

B. Related Work Specified Elsewhere:

1. Section 312000 "Earth Moving"
2. Section 321216 "Asphalt Paving"

1.2 QUALITY ASSURANCE

A. Qualifications of Installers:

1. Provide at least 1 person at all times during execution of this portion of Work and who is thoroughly familiar with the type of materials being installed and is directly responsible for all Work performed under this Section.

B. Requirements of Regulatory Agencies:

1. It is Contractor's responsibility to comply with the requirements of the regulatory agencies, including the purchase of any permits at their own expense.

C. Construction Tolerances:

1. Vertical alignment shall not vary more than 1/8 inch from the edge of a 10-foot straight edge.
2. Horizontal alignment shall not vary more than 1/2 inch from the plan alignment for pavement.
3. Concrete thickness shall not be less than specified.
4. Reinforcing bars shall be placed to the following tolerances:

a. Clear distance to formed surface, plus or minus ¼ inch.
b. Sheared length, plus or minus 1 inch.
c. Concrete cover on top bars in slabs and beams 8 inches deep or less, 2 inches plus or minus 1/4 inch.
d. Concrete cover on top bars in members 8 inches to 24 inches deep, 2 inches plus or minus 1/2 inch.
e. Crosswise or lengthwise spacing, plus or minus 2 inches provided minimum spacing and cover requirements are not violated.

D. Referenced Standards:

1. The current editions of the following American Concrete Institute (ACI) publications shall govern all Work performed hereunder, unless otherwise specified:

    a. Recommended Practice for Concrete Floor and Slab Construction - ACI 302.
    b. Recommended Practice for Hot Weather Concreting – ACI 305.
    c. Recommended Practice for Cold Weather Concreting - ACI 306.
    d. Recommended Practice for Construction of Concrete Pavements and Concrete Bases - ACI 316.
    e. Building Code Requirements for Reinforced Concrete - ACI 318.

E. Design Criteria:

1. Contractor shall employ an approved independent materials testing laboratory and pay for the service of setting up the design mixes and to analyze the fine and coarse aggregate for the various uses of concrete utilized on the project. Design mixes shall be in accordance with the previously cited ACI 318 publication and in compliance with this Specification. The proposed mixes shall be submitted to OWNER for approval prior to placing of any concrete. The approved mixes established by the laboratory shall be used in the Work as long as the characteristics of the ingredients remain unchanged. If any significant change is made in the ingredients, new mixes shall be prepared and submitted to OWNER for approval.
2. Concrete shall consist of a minimum 28 day compressive design strength of 4,000 psi using portland cement, aggregate, air entraining admixture, water and an air content ranging from 5 to 7 percent. Slump of concrete shall have a range of 2 to 4 inches.

    a. If any of the conditions vary from those as described, Contractor shall submit a revised mix design prepared by the testing laboratory along with a written request for the variance desired to OWNER for their consideration and approval.
    b. Concrete for portions of the structure required to be watertight, such as water storage, pumpstation wetwells and waste treatment tanks, shall be air-entrained and have a water-cement ratio not exceeding 0.48.
    c. Admixtures shall be used only with the approval in writing by OWNER. All admixtures shall be used in accordance with the manufacturer's instructions and shall be added at the plant. Calcium chloride shall not be used as an admixture.
    d. Mix designs shall be based on Type I cement. Type III (high early) cement or any other types of cement shall be used only when approved in writing by OWNER. When high-early cement is used, the 7-day strength test shall exceed the specified 28-day strength tests.

1.3 SUBMITTALS

A. Product Data:

1. Prepare and submit product data for OWNER'S approval. Product data shall

include manufacturer's recommended installation instructions.

B. Samples:

1. If requested by OWNER, submit samples for approval of proposed materials.

C. Certification:

1. Submit 3 copies of certification of material compliance as requested by OWNER.

D. Delivery Tickets:

1. Submit a delivery ticket with each truck load of concrete delivered which indicates OWNER'S design mix, truck number, project number, Contractor, ready mix producer, time of batching and total yards of concrete.

E. Test Reports and Design Mixes:

1. Submit 3 copies of design mixes and material test reports to OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Form Material:

1. Form material shall be either sound lumber or steel, free of defects and variations in dimensions. The sides of all lumber shall be surfaced and matched to prevent mortar leakage. Metal forms shall be of standard manufacture and need not be new, but shall be free from rust and dirt. Metal forms shall be flat and true to line without punctures. All form material shall be sized and of strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal of same.

a. Rigid forms are to be utilized on tangent alignment and curves having a radius of 150 feet or greater.
b. Curved forms shall be utilized on the curved Work with a radius of 150 feet or less, and shall consist of flexible spring steel or laminated lumber.

B. Reinforcement Materials:

1. Reinforcing bars and dowels shall be of new billet steel conforming to ASTM A615, Grade 60 (60,000 psi yield). Sizes of bars shall be as indicated on Drawings or herein specified.

a. Dowel bars when used for contraction and expansion joints shall be smooth steel bars coated with a thin uniform coating of liquid asphalt (MC-250) or grease on 1/2 the length of the bar plus 2 inches. In addition, dowel bars for expansion joints shall be furnished with end caps designed with one end closed, a minimum length of 3 inches and be positioned to allow bar movement of not less than 1 inch.

b. Dowel bar assemblies may be permitted if fabricated to the width of the pavement section.
c. Tie bars for control, longitudinal and construction joints shall be deformed bars.

C. Concrete Materials:

1. Portland cement shall conform to ASTM C150.

a. Cement shall be a low alkali cement (Type I) containing not more than 0.6 percent by weight of tri-sodium silicate oxide.

2. Coarse aggregate shall conform to Size 57 grade requirements of Table 2 of ASTM C33 standard.
3. Fine aggregate shall conform to ASTM C33 with fineness modulus not to vary more than 0.20 from value assumed in design mix.
4. Water shall be potable, clean and free from deleterious amounts of acid, alkali or organic material.

D. Admixtures:

1. Air entraining agent shall conform to ASTM C260 and shall be added at the mixer.
2. Water reducing agents, (such as super plasticizers), retarding agents, accelerating agents and all other admixtures, shall require approval by OWNER and if used, shall conform to ASTM C494. In no case shall admixtures be permitted as substitute for cement content specified, unless approved by OWNER.

E. Expansion Joint Material:

1. Joint filler material shall consist of a non-extruding standard bituminous bound type "Sealtight Asphalt Expansion Joint" as manufactured by W.R. Meadows, Inc., Elgin, Illinois or OWNER approved equal.

a. Material shall conform to ASTM D994.

2. Joint filler material shall consist of preformed non-extruded bituminous bound type "Sealtight-Fibre Expansion Joint" as manufactured by W.R. Meadows, Inc., Elgin, Illinois; "Code 1390" as manufactured by W.R. Grace Company, Cambridge, Massachusetts or OWNER approved equal.

a. Material shall conform to ASTM D1751.
b. Material shall be 1/2 inch thick, unless otherwise noted, of widths equal to slab thickness less 1/2 inch or as otherwise indicated.

3. Joint sealant shall be a single component, polyurethane type "Sikaflex-la" as manufactured by Sika Chemical Corporation, Lyndhurst, New Jersey or OWNER approved equal. Color as selected by OWNER.

F. Curing Materials:

1. Kraft paper shall be waterproof and nonstaining "Sisalkraft 5K-10" conforming to ASTM C171.

2. Polyethylene film shall be white opaque sheet or roll material not less than 0.006 inch thick (6 mil) conforming to AASHTO-M171.
3. Contractor may at their option use a liquid curing compound for surfaces that will not receive treating oil or waterproofing membrane. Liquid curing compound shall conform to ASTM C309 and shall consist of the following:

    a. Type 1D, translucent with fugitive dye.
    b. Type 2, white pigmented, Class B (vehicle solids restricted to all resin).

2.2 PRODUCTION

A. Concrete shall be ready-mixed, and shall be batched, mixed and transported in accordance with "Specification for Ready-Mixed Concrete" ASTM C94. The production plant equipment and facilities shall meet the requirements of the National Ready Mixed Concrete Association.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Hot Weather Conditions:

1. The following precautions shall be adhered to:

    a. Reject concrete mixture having temperature of 85ºF or greater.
    b. Pre wet subgrade.
    c. Crushed or flaked ice may be utilized in reducing temperature of mixture.
    d. If necessary, reduce temperature of reinforcing steel with wet burlap.
    e. Reduce mixing time (agitating time) in truck to 45 minutes.
    f. During periods of high winds, shelter windward side with adequate wind breaks.
    g. Apply no chemical retarder to finished surface unless permission is granted in writing by OWNER.

B. Cold Weather Conditions:

1. When ambient temperature is 40ºF or less, the following precautions are to be adhered to:

    a. Subbase shall not be frozen.
    b. Concrete mixture delivered at Worksite shall be 55ºF (minimum), 85ºF (maximum).
    c. No calcium chlorides, salts or other chemical accelerators shall be permitted, unless otherwise acceptable in writing by OWNER.
    d. Concrete surface shall be maintained at a minimum of 50ºF with appropriate thermal insulation for a period of 7 days (normal concrete), 3 days (high early-strength concrete).
    e. Refer to previously cited ACI 306 for minimum thickness of thermal protection required.
    f. Any concrete that has frozen or disintegrated as a result of freezing shall

be removed and replaced at Contractor's expense.

3.2 SUBGRADE PREPARTION

A. Fine grade and compact subgrade to the plan cross section. Compaction shall be as specified in Section 312000 of this Specification or as indicated on the Drawings.

B. After compaction, cut-out soft spots and unstable areas in the subgrade and fill with select fill material and compact as specified in Section 312000.

3.3 GRANULAR BASE

A. Construct the select fill and granular base as shown on Drawings on the prepared subgrade after the final shaping and compacting of the subgrade is completed.

B. Compact as specified base in Section 312000 of this Specification.

3.4 FORM CONSTRUCTION

A. Forms shall have the strength and rigidity, regardless of material, such that when they are set in place and braced, they will withstand weight of equipment and weight of concrete without settlement or lateral displacement.

B. Keyway forms in the edge of pavement slabs and at construction joints shall be constructed to the dimensions shown on Drawings. Wood keyway forms, if used, shall be bolted or nailed to the side forms. Metal keyway forms shall be fixed or held rigidly in place by staking or other OWNER approved method.

C. Forms shall be coated prior to the placement of concrete, with a nonstaining form release agent. Wooden form may be prewetted with water. No standing water, adjacent to forms, shall be permitted.

3.5 REMOVAL OF FORMS

A. Forms for slabs on grade shall not be removed earlier than 12 hours after the placement of concrete has been completed. Within 24 hours of form removal backfill adjacent to the pavement shall be completed.

B. Forms supporting the weight of concrete shall not be released until the concrete has reached its specified 28-day strength. Minimum time elapse after casting and before the false Work supports are released shall be 8 days for spans up to 96 inches center to center of supports, plus 1 additional day for each 12 inches of increase in span length over 84 inches up to 14 days for span of 14 feet and over. Such time period shall be exclusive of those time intervals during which the concrete surface temperature is below 40ºF. If temperature remains below 40ºF during the casting and curing period no forms shall be removed until approved field tests indicating adequate concrete strength have been provided.

3.6 REINFORCEMENT PLACEMENT

A. Tie bars, reinforcement bars and dowel bars shall be clean, free from rust and shall be placed on adequate supports in locations as shown on Drawings. Provide the following minimum thickness of concrete cover:

1. Concrete deposited on ground: 3 inches
2. Formed surfaces against ground: 1-1/2 inches
3. Beams, girders and columns: 1-1/2 inches
4. Slabs, walls and joists: 1 inch
5. Clear distance between parallel bars: 1 inch or nominal bar distance
6. For No. 6 bars or larger: 2 inches
7. No broken brick, block or concrete shall be permitted as reinforcement supports.

B. Welded steel wire fabric shall be placed free from rust, kinks and bends and shall be cut in such a way that the overlap measured between outermark cross wires of each fabric sheet is not less than 2 inches. The fabric shall be cut at contraction joints. It shall be supported by a layer of fresh concrete placed to the depth of the mesh shown on Drawings, followed by placement of the upper layer of concrete.

3.7 JOINTS

A. General:

1. Construct expansion, contraction and construction joints with face perpendicular to surface of concrete.
2. Where joining existing structures, match existing contraction or expansion joints.

B. Expansion Joints:

1. All fixed objects, such as buildings and structures or pavement, sidewalks or curb intersections shall be separated by a 1/2 inch expansion joint placed at the full depth of the concrete thickness. Expansion joints, in addition to the above, shall be placed at 60 foot intervals in the following:

    a. Concrete curb and gutter
    b. Concrete walk

C. Construction Joints:

1. Contraction joints shall be placed at the following intervals and dimensions or as shown on Drawings:

    a. Concrete curb and gutter – 10 feet; 1/8 inch wide by 1 1/2 inch depth.
    b. Concrete walk – 10 feet; 1/8 inch wide by 1/4 the depth of concrete.

2. Cut plastic concrete with appropriate tool to specified depth. Finish edges with 1/4 inch radius tool.
3. Saw-cut joints to specified width and depth on hardened concrete as soon as concrete has hardened sufficiently to prevent raveling or damage to the joint.

D. Joint Sealer:

1. Apply joint sealer to a clean and dry expansion or contraction joint if specified to a point approximately 1/4 inch below the top surface. Where oil treatment is specified, joint sealer shall be applied prior to application of the oil.

3.8 CONCRETE PLACEMENT

A. Place concrete to required depth and width to form a continuous mass requiring a minimum of rehandling. Concrete adjacent to side forms and fixed structures shall be consolidated by means of portable vibrators or by mechanical means with the use of hand spading. Vibrators shall not be used to move concrete horizontally.

B. If it is necessary to place a construction joint prior to a contraction joint, the distance between the construction joint and the previous contraction joint shall not be less than 60 inches.

C. Automatic machine may be used for curb and gutter placement at Contractor's option, if acceptable to OWNER. If machine placement is to be used, submit revised mix design and laboratory test results, which meet or exceed the minimum herein specified. Machine placement must produce curbs and gutters to the required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.9 CONCRETE FINISH

A. After initial strike-off and floating, and prior to finishing, test surface with 10-foot straightedge. Correct irregularities prior to final finishing operations.

B. Apply the following surface finish after surface sheen or excess moisture has disappeared:

1. Apply steel trowel finish followed by stiff-bristled broom drawn across concrete surfaces, perpendicular to line of traffic:

    a. Sidewalk
    b. Concrete pavement
    c. Curb and gutter

3.10 CONCRETE CURING AND PROTECTION

A. Cure concrete surfaces for 7 days (normal concrete) and for 3 days (high early-strength concrete), using appropriate means of protection as previously cited in ACI 305 and ACI 306.

B. Curing methods shall consist of one of the following:

1. Keep concrete surface continuously wet by ponding with water.
2. Apply moisture proof fabric to entire area lapping joints and edges at least 3 inches. Tape interior joints and weight edges down with sand or other approved material.
3. Apply liquid membrane curing compound to the finished surface in a 2 coat

continuous operation with second application applied transversely to the direction of the first application, and in accordance with the manufacturer's directions. Replace damaged areas with equal applications of membrane using compound. Liquid membrane curing compound shall not be permitted where the surface will be subjected to an application of waterproof coatings, bonding agents, treating oil or paint.

3.11 TESTING AND EVALUATION

A. Concrete materials and operations shall be tested and inspected as the Work progresses, by an independent testing laboratory. Contractor shall furnish any necessary labor who is familiar with methods of sampling and shall assist the testing agency in obtaining and handling samples, and for safe storage and proper curing of concrete test specimens on Worksite.

B. Mold and cure three standard 6-inch diameter specimens from each sample in accordance with ASTM C31. Compressive strength test specimens shall be in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. The acceptance test results shall be the average of the strengths of the two specimens tested at 28 days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded. When high-early strength concrete is used, the first specimen shall be tested at 3 days; the remaining two at 7 days.

C. Make at least one strength test for each 50 cubic yards, or fraction thereof, of each mix design of concrete placed in any one day.

D. Determine slump of the concrete sample for each strength test and whenever consistency of concrete appears to vary, using standard slump cone as per ASTM C143.

E. The testing laboratory shall report all test and inspection results to OWNER, OWNER’S Engineer, and Contractor immediately after they are performed. All concrete test reports shall include name of job, date of placement, date of test, batch mix design, slump and the exact location in the Work at which the batch represented by the test was deposited.

F. All costs necessary to prepare concrete test cylinders, make tests and furnishing of written reports shall be borne by the Contractor.

3.12 DEFECTIVE WORK

A. When tests and inspections of the aggregate base and/or concrete Work indicate non-compliance with the Specification, Contractor and OWNER shall mutually agree on the number and location of additional tests to define and/or verify the deficiency. If the average of the tests for a given area indicate non-compliance the area is considered defective and Contractor shall:

1. Remove and replace defective Work at no cost to OWNER;
2. Correct the Work at no cost to OWNER in a manner acceptable to OWNER;

3. Give OWNER a credit towards the Contract Price if it is acceptable to OWNER;
4. If Work is found to be in noncompliance, Contractor shall pay for the defective area removal and replacement, and the tests and inspection costs; or
5. If Work is found to be in compliance, OWNER shall pay for tests and inspection costs.

END OF SECTION

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Joint-sealant backer materials.
4. Primers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: for each type of product

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

C. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer 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 SEALANT

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-APPIED JOINT SEALANT

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.

D. D 6690, Type IV.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; 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.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 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. Cleaning of Joints: Clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

C. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer.

D. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

E. Install joint-sealant backers 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 backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

F. Install joint sealants immediately following backer material 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.

G. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with 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.

H. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

I. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

END OF SECTION

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete wheel stops.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Precast concrete wheel stops.

B. Samples for Verification: For wheel stops, 6 inches long, showing color and cross section; with mounting hardware.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring to substrate.

C. Securely anchor wheel stops to substrate 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 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Painted markings applied to asphalt paving.
2. Painted markings applied to concrete paving and surfaces.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

B. Markings Standards: Comply with applicable MUTCD current Standards.

2.2 PAVEMENT MARKING PAINT

A. MPI #97, latex traffic-marking paint.

1. Asphalt Application

a. Color: Pantone Cool Gray 3 C or approved equal.

2. Concrete Application

a. Color: Pantone Cool Gray 10 C or approved equal.

3. Fire Lane Application

a. Color: Pantone 484 C or approved equal.

4. ADA Application Colors:

    a. Pantone 7691 C or approved equal.
    b. Pantone Cool Gray 3 C or approved equal (asphalt).
    c. Pantone Cool Gray 10 C or approved equal (concrete).

B. Glass Beads: AASHTO M 247, Type 1.

2.3 PAVEMENT MARKING THERMOPLASTIC

A. All public rights of way shall receive thermoplastic markings stipes. Color to be approved through submittal.

1. Color: White or Yellow

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or 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.

END OF SECTION

SECTION 321726 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Detectable warning unit pavers.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of exposed finish requiring color selection.

C. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering and wear.
b. Separation or delamination of materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material , setting material , anchor , and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING UNIT PAVERS

A. Setting Bed: Comply with manufacturer's specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING UNIT PAVERS

A. Unit Paver Installation, General:

1. Setting-Bed and Unit Paver Installation: Comply with installation requirementsper manufacturer.
2. Mix unit pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
3. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
4. Tolerances: Do not exceed 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Decorative aluminum fences and gates.
B. Specialty Gate Hardware

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.
B. Section 31 23 16 - Excavation.

1.3 REFERENCE STANDARDS

A. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Approximately two weeks prior to scheduled commencement of installation and associated work, meet at project site to discuss conformance with requirements of specification and job site conditions. Representatives of the architect, contractor, installer, and other parties who are involved in the scope of this installation shall attend the meeting. Review submittals, specific concerns related to site conditions, installation methods, and other work governing the quality of the installation.

1.5 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Product Data: Material descriptions, dimension of individual components and profiles, and finishes for the following:
   1. Fence, gate posts, brackets, rails and fittings.
   2. Gates and hardware.
C. Shop Drawings:
   1. Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.
   2. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
   3. Foundation details, concrete design mix and reinforcing schedule for anti-ram barrier system.
D. Samples: Submit two samples of each other the following:
   1. Provide up to six different powder coat samples (3 inch by 6 inch samples of powder coat)
   2. Pattern Sample: Submit two (2) 12 inch by 12 inch flat panel.
E. Manufacturer's Installation Instructions.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Manufacturer's Warranty.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer Qualifications: An experienced installer who has completed installations of fences and gates similar in material, design, and extent to those indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

1.7 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a one year period after Date of Substantial Completion.
C. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.
D. Warranty on FEVE and PVDF finishes: Manufacturer's standard **tenyear** warranty on finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Decorative Metal Fences Panels:
    1. Basis-of-Design Product: Provide Omega UNIK Solid Vertical system as manufactured by Omega II Fence Systems; Tel: 800-836-6342 / 450-686-9600; www.omegafence.com, or comparable product of other manufacturers approved by the Architect.
    2. Substitutions: See Section 01 60 00 - Product Requirements.
    3. Request for substitutions will be considered in accordance with the provision of Section 01 25 00 Substitution Procedures.

2.2 FENCES

A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
    1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.

2.3 ALUMINUM FENCE

A. Decorative Aluminum Fence System: Provide fence meeting the Test Load and Coating Performance requirements of ASTM F2408 for Industrial class.
    1. Fence Panels:
        a. Orientation: Vertical
        b. Size: As indicated on drawings.
        c. Made of 5052-H32 aluminium sheet, 1/8 in (3.2 mm) thick.
        d. Pattern: Solid Panel.
    2. Flat Post
        a. hot-dip galvanized in accordance with ASTM A123 Grade 100.
        b. 2-1/2 in (63.5 mm) x 1/4 in (6.4 mm) thick.
        c. Installed on base plates.
    3. Post Brackets:
        a. 5/16 in (7.9 mm) tamper-proof nut and carriage bolt, all stainless steel.
        b. Vertical panels: 3 bolts per post
    4. Post Caps: Flush (no caps)
    5. Polyester powder coating:
        a. Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:
            1) Mechanical adhesion test as per ASTM D3359 - Method B.
            2) Shock resistance tests as per ASTM D2794.
            3) Salt spray testing with a minimum of 1 000 hours without red rust appearance, as per ASTM B117.

4) Humidity resistance in a weather meter chamber as per ASTM D2247.
5) Exposure to ultraviolet light with exposure of 1 000 hours using apparatus Type E and 63°C as per ASTM D1499.

b. Color: Metallic Silver.

2.4 GATES

A. Configuration:
1. Single swing

B. Gate Frame:
1. Two (2) horizontal tubes and two (2) vertical tubes, all 2 in x 2 in (50.8 mm x 50.8 mm) 16 gauge (1.6 mm) square tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.

C. Gate Post:
1. Cold rolled from 1008 grade steel to meet ASTM A500 and ASTM A787. Posts are to include cap and are fixed to the door frame using two (2) hinges. Length as required for installation type:
2. Installation: In-ground, post length as required for local frost line requirements.
3. Post Size: For fences with 8-foot-high nominal panels:

OPENING DIMENSION	OPENING DIMENSION
3 FT TO 6 FT	**3 IN X 3 IN (76.2 MM X 76.2 MM) 11 GAUGE (3.0 MM)**
> 6 FT TO 8FT	**4 IN X 4 IN (101.6 MM X 101.6 MM) 11 GAUGE (3.0 MM)**
> 8 FT TO 19 FT	**6 IN X 6 IN (152.4 MM X 152.4 MM) X 3/16 IN (4.8 MM)**

2.1 GATE HARDWARE

A. Standard Hardware:
1. Hinge: Structurally designed to support all gates without deformation during opening and closing. Allows a 180º rotation during both opening and closing.
2. Panic Bar and Plate: Prep to receive egress hardware for quick exit during an emergency. Reference Section 08 06 71 - Door Hardware Schedulefor hardware specification.

2.2 ACCESSORIES

A. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
B. Mounting Kit, including pedestal.

2.3 MATERIALS

A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations or blemishes; unless allowed for specific metal types.
B. Aluminum Sheet: AA5052-H32, 0.125-inch (3.2 mm) thick.
C. Flat Post hot-dip galvanized in accordance with ASTM A123 Grade 100.
D. Concealed Structural Supports: Aluminum and dissimilar metal isolation.
E. Fasteners: ASTM F593 stainless steel.

2.4 FABRICATION

A. Fabricate assemblies to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish and anchorage, but not less than required to support structural loads.
B. Fabricate in accordance with approved shop drawings and manufacturers written instructions. Form work true to line and level with accurate angles and surfaces.
C. Assemble in the shop to greatest extent possible to minimize field splicing and assembly.
D. Cut, drill and laser cut metals cleanly and accurately. Remove burrs and ease edges; unless allowed for specific metal types and . Remove sharp or rough areas on exposed surfaces.
E. Cut, reinforce, drill and tap as indicated to receive finish hardware, screws and similar items.
F. Use grommets, bushings and washers or methods as recommended by the manufacturer for separation of dissimilar metals.

2.5 FINISHES

A. Polyester Coating:

1. Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire, panel and post sections. Coating shall be capable of withstanding the following
    a. Mechanical adhesion test as per ASTM D3359 - Method B.
    b. Shock resistance tests as per ASTM D2794.
    c. Salt spray testing with a minimum of 1,000 hours without red rust appearance, as per ASTM B117.
    d. Humidy resistance in a weather meter chamber as per ASTM D2247.
    e. Exposure to ultraviolet light with exposure of 1,000 hours using apparatus Type E and 63 degree C as per ASTM D1499.
2. Colors:
    a. Metallic Silver.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
B. Do not begin installation until substrates have been properly prepared.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 ft (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
B. Clean surfaces thoroughly prior to installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Set fence posts in accordance with the manufacturer recommended spacing.
C. When cutting rails immediately seal the exposed surfaces by:
    1. Removing metal shavings from cut area.
    2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
    3. Apply two coats of custom finish spray paint matching fence color.
    4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.
D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
    1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
    2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
    3. Provide gate hardware by the manufacturer of the gate and install in compliance with manufacturer's recommendations.
E. Excavate post holes in accordance with Section 31 23 16.
F. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From Indicated Position: 1 inch.
C. Minimum Distance from Property Line: 6 inches.

3.5 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
C. Post Settings: Randomly inspect three locations against design for:
    1. Hole diameter.
    2. Hole depth.
    3. Hole spacing.
D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
E. Gates: Inspect for level, plumb, and alignment.
F. Workmanship: Verify neat installation free of defects.

3.6 CLEANING

A. Leave immediate work area neat at end of work day.
B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
C. Clean fence with mild household detergent and clean water rinse well.
D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.7 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

3.8 PROTECTION

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

END OF SECTION 32 31 19

SECTION 328400 - LANDSCAPE IRRIGAITON PERFORMANCE SPECIFICAITON

PART 1 - GENERAL

1.1 DESCRIPTION

A. It is the intent of this Specification that a finished system is complete in every respect and shall be ready for operation satisfactory to the Landscape Architect and Owner. The design is to be delegated by the contractor and approved by the Landscape Architect

B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated in these Specifications, and as necessary to complete the contract Section 321123 "Aggregate Base Course" for aggregate subbase and base courses.

C. Section Includes:

1. Pipe and fittings, valves, outlets, backflow preventer, and accessories.
2. Connection to utilities and meter installation.
3. Automatic control system

1.2 REFERENCES, DEFINITIONS AND APPLICABLE STANDARDS

A. ASTM D 1785 - Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR)

B. ANSI/ASTM D 2564 - Solvent Cement for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

C. Reference and comply with applicable plumbing codes, standards, or specifications by building code or governing utility authority for the project location.

D. Rain Bird Irrigation Installation Details and Specifications.

E. Irrigation Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote control, signaling power-limited circuits.

G. Notice of Completion: The date at the close of the Maintenance Period when the work has been completed, checked, accepted, and written approval of the work has been given by the Architect.

H. Date of Acceptance: The date at the end of the warranty periods as specified herein, and written acceptance has been given by the Architect.

I. Finish Grade: Elevation of finished surface of planting soil within 1/10th of an inch

1.3 GENERAL DESIGN SYSTEM REQUIREMENTS

A. Contractor's delegated design for an automatic 2-wire system, electric valve, irrigation system with 100 percent coverage and minimal over spray onto buildings and paved surfaces to meet the following design standards:

1. Compliance with all applicable plumbing codes for the project location.
2. Irrigation water meter and tap to be provided as part of the irrigation system. Meter size and location to be determined by contractor’s system design and coordination with owner and general contractor.
3. General Contractor to provide irrigation system sleeving under pavement crossings at the locations and sizes shown in the irrigation shop drawings. Coordinate with General Contractor to provide any additional sleeves that may be necessary.
4. Provide backflow preventer assembly with insulated housing. Provide automatic controller, control wiring, and hardwired connections to power source. Coordinate controller location with owner, general contractor and electrical contractor.
5. Provide wireless rain and heat sensor device to shut off, delay, and adjust watering cycle times.
6. Pipe sizing must provide for a maximum velocity of 5 feet per second and must provide adequate pressure delivery at all heads for proper performance.
7. Provide separate valve zones for turf and planted bed areas.
8. Provide pop-up spray and/or rotor type outlets for turf areas.
9. Space spray and/or rotor type outlets to provide near 100% overlapped coverage between each outlet.
10. Provide drip irrigation for planted bed areas.
11. Provide drip pop up indicators at all drip areas.
12. Provide additional drip emitters for trees in drip zone areas.
13. Coordinate the locations of controller and backflow preventers to minimize visibility and screen with landscape materials where possible.
14. Piping to be located along back of curbs, pavement edges, and bed edges.
15. Spray from perimeter of areas where feasible.
16. Provide 100% coverage of all newly planted landscape areas on site and in adjacent street rights-of-way and/or other areas as indicated in the Landscape Plan.
17. Provide manual drain valves and sumps, or piped connections to drainage system in sufficient locations to drain the entire system for winterizing.
18. Provide valve boxes and covers at all locations described. Align all valve boxes parallel or perpendicular to adjacent hardscape where applicable.
19. Minimize the number of outlets, trenching, and pipe installation where possible.

1.4 PRE-CONSTRUCTION SUBMITTALS

A. Contractor to provide a delegated design for a fully automated 2- wire irrigation system to be reviewed and approved by the Landscape Architect through shop drawings.

B. Product Data:

1. Prior to ordering of any materials, and for each type of product indicated provide

submittals for acceptance by the Landscape Architect. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. The submittals shall include the following information:

    a. A title sheet with the job name, the Contractor's name, address and telephone number, submittal date and submittal number.
    b. Shop Drawings with the following clearly indicated: Irrigation layout plan showing the sleeving locations, mainline routing, lateral line routing, controller location, meter location, backflow location and head or drip line locations.
    c. An index sheet showing the item number (i.e. 1, 2, 3, etc.); an item description (i.e. sprinkler head); the manufacturer's name (i.e. Rain Bird); the item model number (i.e. 44DLRC); and the page(s) in the submittal set that contain the catalog cuts.
    d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled or highlighted on the catalog cuts.
    e. Submittals for equipment shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.

3. Submittal format requirements:

    a. Submittals shall be provided as one complete package for the project. Multiple or partial submittal packages will not be reviewed.
    b. Submittal package shall be submitted as a single PDF file.

1.5 POST CONSTRUCTION SUBMITTALS

A. Record Drawings:

1. Record accurately on one set of drawings all changes in the work constituting departures from the original approved Shop Drawings and the actual final installed locations of all required components as shown below.
2. Record Drawings shall be prepared to the satisfaction of the Architect. Prior to final inspection of work, submit Record Drawings to the Architect.
3. Show locations and depths of the following items:

    a. Point of connection (including water POC, basket strainer, pressure regulator, master control valve, flow sensors, etc.)
    b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing.)
    c. Isolation valves.
    d. Mainline air release valves.
    e. Automatic remote-control valves (indicate station number and size.)
    f. Quick coupling valves.
    g. Routing of control wires where separate from irrigation mainline.
    h. Irrigation controllers
    i. Related equipment (as directed)

B. Controller Charts:

1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
2. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness. The contractor is to provide a minimum of three (3) copies to the owner.

1.6 FIELD QUALITY CONTROL

A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.

B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the Specifications.

C. All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out. Anything contained in these Specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these Specifications call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these Specifications shall take precedence.

D. Materials supplied for this project shall be new and free from any defects. Defective materials shall be replaced immediately at no additional cost.

E. Secure the required licenses and permits including payments of charges and fees, give required notices to public authorities, verify permits secured or arrangements made by others affecting the work of this section.

F. Acquire certificate of compliance from local authority indicating approval of backflow preventer installation.

1.7 FIELD MEASUREMENTS

A. Verify that field conditions are as shown in the drawings. Revise design and record drawing as required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

D. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and at no additional cost.

1.9 PROJECT CONDITIONS

A. Verify and determine the locations, size and detail of points of connection provided as the source of water and electrical supply to the irrigation system.

B. Irrigation design shall be based on the available water pressure. Verify the dynamic water required is available on the project prior to the start of construction. Should a lack of pressure exist to achieve the flow necessary to operate the system, notify the Landscape Architect prior to beginning construction.

C. Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities that are commonly encountered underground, and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, promptly notify the Landscape Architect who will arrange for relocations. Proceed in the same manner if a rock layer or any other such conditions are encountered. Call in utility locates prior to all trenching or excavation.

D. Protect all existing utilities and features to remain on and adjacent to the project site during construction. Repair, at Contractor’s own cost; all damage resulting from Contractor’s operations or negligence.

E. Coordinate installation of required sleeving per approved Shop Drawings

F. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied, unless permitted under the following conditions and then only after arranging to provide temporary water service according to the requirements indicated:

1. Notify Water Utility provider prior to Interruption.
2. Notify Architect no fewer than two working days (48 hours) in advance of proposed interruption of water service.
3. Do not proceed with interruption of water service without the Architect’s written permission.

1.10 GUARANTEE

A. The entire irrigation system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the approved final acceptance.

B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to the Owner within ten (10) calendar days of receipt of written notice from the Landscape Architect. When the nature of the repairs as determined by the Landscape Architect constitutes an emergency (i.e. broken mainline) the Landscape Architect may proceed to make repairs at the Contractor's expense. Damages to existing improvement resulting either from faulty materials or workmanship shall be repaired to the satisfaction of the Landscape Architect by the Contractor, all at no additional cost.

C. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Rain Bird Corporation, Turf Division or Hunter Industries: For all irrigation system equipment and accessories.

B. NDS: For valve boxes.

C. Wilkins/Zurn: For backflow preventers

2.2 MATERIALS

A. Pipe:

1. PVC in accordance with ASTM D 1785: PVC Schedule 40 pipe for all sleeving, main lines, lateral lines, and fittings throughout system. Solvent-weld sockets.
2. Rigid copper pipe required from tap at public main through backflow preventer.

B. Fittings: Type and style of connection to match pipe.

C. Solvent Cement: ANSI/ASTM D 2564 for PVC pipe and fittings.

D. Tracer Wire: 14 AWG solid copper wire with insulating cover, to be tagged as “Tracer wire” with metal tags. Color of insulating cover must be different from other wiring.

E. Turf Outlets:

1. Spray Outlets: Pop-up spray bodies, 6 inch minimum to 12 inch riser heights as needed for adequate performance, with installed check valves and pressure

regulating devices.

2. Stream Rotor Outlets: Pop-up stream rotor bodies, 6 inch and/or 12 inch riser heights as needed for adequate performance, with installed check valves and internal pressure regulating devices. Rotors without internal pressure regulation may be used if combined with a pressure regulating PVC pipe swing joint.

F. Drip System Outlets:

1. Drip Line: Pressure compensating surface type installation drip line with flexible tubing, 12 inch emitter spacing, and internal emitter check valves. Anchor line with galvanized wire anchors at 24”-30” spacing. Lines and connector fittings must be capable of operating at 50 PSI without supplementary clamps.
2. Drip Emitters: Pressure Compensating drip emitters for additional water to tree placements within drip zones; one drip emitter for each ornamental size tree and two drip emitters for each medium or large size tree. Provide diffuser caps for each emitter.

2.3 BACKFLOW PREVENTERS

A. Control Valves: Electric solenoid operating valves with glass filled nylon body construction. Size valves for minimum pressure loss for designed flow rate. Provide and install pressure regulating devices for each valve placement.

B. Backflow Preventer: Wilkins/Zurn: 975XL or 975XLSEU backflow preventer sized for maximum flow in system with a maximum pressure loss limited to 10% of available residual pressure.

2.4 CONTROLS

A. Controller: Automatic controller for electric valve operation sized for required number of stations, with grounding per manufacturer specifications and hardwired connections to power source.

B. Controller Housing:

1. Indoor Installations: Wall mount plastic housing with lockable access door. Indoor installations must be able to accommodate wiring or wireless system remote operation of rain and heat sensing device. Coordinate with electrician for power source
2. Outdoor Installations:

a. Wall Mount: Stainless steel housing with lockable access door.
b. Ground Mount: Stainless steel housing and pedestal with lockable access door.

C. Accessories: Include required fittings, galvanized metal electrical conduit, and accessories for installation.

D. Control Wiring: Gauge of wire to be sized by contractor for adequate operation of valves. Use waterproof connectors for all connections. Use different color wire jackets

for valve power wires and white jacket for common wire.

E. System Grounding: Provide grounding at controller and throughout control wiring and valve layout to meet manufacturer's standards with grounding devices as recommended by manufacturer.

F. Rain and Heat Sensor Device: Wireless automatic, adjustable, shutoff device to disable/delay operations during or after recent rainfall and adjust watering cycle times for local heat and rainfall conditions. Provide and install connection equipment necessary for operation at controller.

2.5 OTHER EQUIPMENT

A. Swing Joints: Provide PVC pipe swing joints for all full circle rotor outlet placements.

B. Pressure Regulating Swing Joints: Provide pressure regulating PVC pipe swing joints for all rotor outlet placements without internal pressure regulation.

C. Valve Boxes and Covers: Valve boxes and covers required for all control valves, drip filters, drain valves, surge protector devices, wiring changes of direction, and wiring junctions.

D. Drip Filters: Replaceable and/or cleanable sized to match zone flows, installed with valve in valve box.

E. Drain Valves: Manual, PVC valves on tees for low points in system.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify location of existing utilities. Repair utilities damaged as a result of this work at no increase in Contract Sum.

C. Verify that required utilities are available in proper location and ready for use.

D. Verify available water pressure at meter or backflow preventer locations.

E. Verify sleeve locations.

F. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

A. Layout and stake locations of system components.

B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system. Notify Architect/Engineer for approval of field changes to system design.

C. Coordinate location of controller, rain and heat sensor device, and connections to power source with Owner, General Contractor, and Electrical Contractor.

3.3 TRENCHING

A. Minimum Trench Depth: Trench depth must provide a minimum of 18 inches of cover over all main lines and wiring and 12 inches of cover over all lateral lines.

B. Trench to accommodate grade changes and slope to manual drain valves at low points in system.

C. Maintain trenches free of rocks, obstructions, or other debris that may damage pipe or wiring.

D. Repair or replace existing improvements damaged by work performed under this contract with equivalent materials or products.

3.4 INSTALLATION

A. Install irrigation sleeving under all pavement crossings and buried at a minimum depth of 18 inches below finish grade. All sleeving trenches must match finish grade and be compacted to minimum subgrade requirements for paving.

B. Install pipe, backflow preventer, valves, valve boxes, wiring, grounding, drains, controls, and outlets in accordance with all applicable plumbing codes, manufacturer's details, instructions, and minimum standards.

C. Trenches for irrigation main and lateral lines must match finish grade and be compacted to the degree that no settlement will occur.

D. Install cast concrete thrust blocking at all piping bends for 3 inch or larger pipe sizes.

E. Install zone valves with pressure regulating devices in valve boxes per manufacturer specifications and details. Provide metal tag with zone number for each valve.

F. After piping is installed but before sprinkler heads are installed and trenches backfilled, open valves and flush system with full head of water.

G. Install spray and rotor outlets with fittings, flex pipe, swing joints, etc. Use threaded connections to lateral lines. Install in accordance with manufacturer's details, instructions and minimum standards.

H. Install drip lines, emitters, filters, fittings, etc. in accordance with manufacturer's details, instructions and minimum standards. Anchor line with galvanized wire anchors at 3 feet on center, minimum spacing.

I. Install manual drain valves at system piping low points and pipe connections from valves to site drainage system, or, provide 12" diameter by 24" deep, gravel filled drain sumps where piped connections are not feasible.

J. Connect to water and electrical services.

K. Set outlets and box covers at finish grade elevations.

L. Install control wiring in trenches along with main lines to valves and provide 30-inch expansion coil at each valve and change of direction. Also provide 30-inch expansion coils at 100-foot intervals between valves.

M. Tracer Wire: Install tracer wire from gate valve at backflow preventer along all main lines to each zone valve. Terminate at valve boxes with 24” wire coil and metal tags labeled as “Tracer Wire.”

N. Install automatic controller. Provide hardwired connection to power source, enclose wiring to system and power source in rigid metal conduit where exposed. Paint exposed conduit to match building exterior.

O. Install rain and heat sensor device and wireless connection device to controller. Verify proper operation of device.

P. Program remote irrigation controller and install connection equipment necessary for operation at controller. Verify proper operation of remote.

Q. Repair or replace any other work or improvements damaged as a result of work related to system installation at no increase to the Contract Sum.

3.5 FIELD QUALITY CONTROL

A. Prior to backfilling and installation of outlets, cap or plug pipes and test system for leakage. Maintain maximum available pressure for one hour. Piping is acceptable if no leakage or loss of pressure occurs during test period.

3.6 ADJUSTING

A. Adjust control system to achieve time cycles required for adequate watering at time of installation.

B. Adjust heads and/or nozzles to achieve proper coverage and performance. Make nozzle or head changes as necessary for proper coverage.

C. Adjust zone valves for proper operating pressures at valve zones.

3.7 EXTRA MATERIALS

A. Furnish to Owner the following extra components:

1. Two sprinkler heads of each type and size.
2. Two nozzle inserts for each type and size.
3. Two drip emitters of each type and size
4. Two drip line basket filters of each type and size.
5. Two keys each for valve boxes and controller (if locked boxes are used).
6. Two of any required special tools for adjustment or replacement of each type of outlet, nozzle, valve, and other system equipment.

3.8 CLOSEOUT

A. Provide system demonstration to Owner and Architect/Engineer for review and final acceptance of work. Coordinate demonstration of procedures for winterizing (draining system lines, backflow preventer, etc.) and spring start-up with Owner. Review system operation and components during service visit.

B. Instruct Owner or representative in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

C. Deliver record drawing of system, required operation and maintenance information, extra materials and backflow preventer certificate to Owner at the instruction meeting.

D. Provide system demonstration to Owner and Architect/Engineer for review and final acceptance of work. Coordinate demonstration of procedures for winterizing (draining system lines, backflow preventer, etc.) and spring start-up with Owner. Review system operation and components during service visit.

E. Instruct Owner or representative in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

F. Deliver record drawing of system, required operation and maintenance information, extra materials and backflow preventer certificate to Owner at the instruction meeting.

3.9 WARRANTY

A. Provide one-year materials and workmanship warranty on all system components and installation beginning on date of acceptance of the work.

B. Replace failed components immediately upon notification by Owner or Architect/Engineer.

END OF SECTION

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete and thorough preparation of the planting soil, including soil amendment products, imported topsoil, as required, to make up deficiencies in quantity of soil available on site, as shown in the Contract Drawings, and as specified herein this Section.

B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:

1. Agronomic Soil Fertility Testing and Soil Percolation Testing.
2. Topsoil.
3. Pre-Plant Weed Control.
4. Soil Conditioners, Amendments and Fertilizers (Organic & Chemical).

C. Related Requirements:

1. Section 312000 "Earth Moving"
2. Section 329300 "Plants" for placing planting soil for plantings.
3. Section 328400 "Landscape Irrigation Performance Specification"
4. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.

1.2 DEFINITIONS AND APPLICABLE STANDARDS

A. References:

1. USDA – United States Department of Agriculture.
2. ASTM – American Society for Testing & Materials.

B. Definitions:

1. Topsoil - Shall be friable soil, providing sufficient structure in order to give good tilth and aeration to the soil. Topsoil shall be free of roots, clods, stones larger than one-inch (1”) in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
2. Gradation Limits - Soil shall be a sandy loam, loam, clay loam or clay. The definition of soil texture shall be per the USDA classification scheme. Gravel over ¼-inch in diameter shall be less than 20% by weight.
3. Permeability Rate - Hydraulic conductivity rate shall be not less than one-inch (1”) per hour, nor more than twenty-inches (20”) per hour, when tested in accordance with the USDA Handbook Number 60, Method 34b, or other

approved Methods.

4. Fertility - The range of the essential elemental concentration in soil shall be as follows: (cont. next page) Ammonium Bicarbonate/DTPA Extraction (PPM) Element Concentration of elements for Soil Selection, measured as mg/kilogram dry weight basis Concentration of Elements for Final Acceptance (amended and conditioned soil) measured as mg/kilogram dry weight basis Phosphorus 2 - 40 10 – 40 Potassium 40 - 220 100 – 220 Iron 2 - 35 24 – 35 Manganese 0.3 - 6 0.6 – 6 Zinc 0.6 - 8 1 – 8 Copper 0.1 - 5 0.3 – 5 Boron 0.2 - 1 0.2 – 1 Magnesium 50 - 150 50 – 150 Sodium 0 - 100 0 – 100 Sulfur 25 - 500 25 – 500 Molybdenum 0.1 - 2 0.1 - 2
5. Acidity - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 – 7.9.
6. Salinity - The salinity range measured in the saturation extract (Method 3a, USDA Hand Number 60) shall be 0.5 – 2.0 dS/m. If calcium and if sulfate ions both exceed 20 milli-equivalents per liter in the saturation extract, the maximum salinity shall be 4.0 dS/m.
7. Chloride - The maximum concentration of soluble chloride in the saturation extract (Medoth3a, USDA Handbook Number 60) shall be 150 mg/1 (parts per million).
8. Boron - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/1 (parts per million).
9. Sodium Adsorption Ratio (SAR) - The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60.
10. Aluminum – Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3.0 parts per million.
11. Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 5%. The carbon/nitrogen ratio should be about 10. A high carbon/nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
12. Calcium Carbonate Content - Free calcium carbonate (limestone) shall not be present in acid-loving plants.
13. Heavy Metals - The maximum permissible elemental concentration in the soil shall not exceed the following concentrations: (cont. on next page) Ammonium Bicarbonate/ DTPA Extraction (PPM) Element (mg/kilogram) dry weight basis Arsenic 1.0 Cadmium 1.0 Chromium 10.0 Cobalt 2.0 Lead 30.0 Mercury 1.0 Nickel 5.0 Selenium 3.0 Silver 0.5 Vanadium 3.0

    a. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50% to the above values. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75% of the above values. No more than three (3) metals shall be present at 50% or more of the above values.

14. Phytotoxic constituent, herbicides, hydrocarbons, etc. – Germination and growth of plants shall not be restricted more than 10% compared to the reference soil. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Method No. 8020.
15. Sub Grade - Soil level resulting from the rough grading work under another Section. Cultivation of sub grade areas prior to placement of Topsoil is included

in this Section.

16. Stockpiled Topsoil - Soil stockpiled for spreading over prepared sub-grade.
17. Stockpiled Native Topsoil - Topsoil stripped from the site prior to rough grading Work (under another Section), to be spread and amended as Work under this Section.
18. Imported Topsoil - Off-site Topsoil, imported and stockpiled under this Section, to be spread and amended as Work under this Section.

C. Measurements:

1. PPM: Measurement, in parts per million.

1.3 QUALITY ASSURANCE

A. Installer Qualifications for requirements indicated herein this Section:

1. Licensed Landscape Contractor, in the State of Arkansas.

a. Engage an experienced, licensed Contractor who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
b. Installer's Field Supervision: Contractor shall maintain an experienced, full-time landscape supervisor/superintendent at the Project Site during times that landscaping operations identified herein the Contract are in progress.

B. Manufacturer’s Directions: Follow Manufacturer’s directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings or Contract Specifications.

C. Permits, Fees, Bonds, Testing, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, testing, and inspections necessary to perform and complete his portion of the Work.

D. Approved Testing Laboratory and Procedures for Agronomic Soil Fertility Analyses:

1. Agronomic Soil Fertility Analyses shall be conducted by a reputable, certified, agronomic soils laboratory. Laboratory shall be a member of the Council on Soil Testing and Plant Analysis. The same laboratory shall be used throughout the duration of the Contract:
2. Contractor shall verify and confirm the selected Testing Laboratory and specific location(s) of soil sample(s) with the Landscape Architect prior to commencing soil sampling operations.
3. For each Soil type, submit the physical Soil Samples directly to the selected Laboratory for analysis, per the procedures outlined per Part III herein this Section.

a. In addition to the physical Soil Samples, Contractor shall also provide the Laboratory with a copy of the Soil Amendment and Fertilizer products indicated herein this Section.

4. Along with the testing data results, the Agronomic Soil Fertility Analysis shall

also include written recommendations authored by the Laboratory conducting the Analyses for amending, treating, and/or correcting the sampled soils. Laboratory shall utilize the organic-based Soil Amendments and Fertilizers described herein this Section to the greatest extent possible to produce satisfactory planting soil(s) suitable for sustaining healthy viable plant growth.

a. The Analyses shall also include Maintenance and Post-Maintenance fertilization programs for planted areas within the Contract.

5. Agronomic Soil Fertility Analyses shall be performed on each Soil Type samples, and include testing results for the following pH Electro-conductivity (salinity) measurement – saturated extract. Measurement of sodicity (Sodium Absorption Ratio) Estimate of soil texture and soil organic matter Presence of lime Nutrients/Toxic Elements measurement of DPTA extract Saturation extracts for nitrate, sulfate, sodium, calcium, magnesium, potassium, soluble phosphate, and boron Parasitic nematodes Herbicide contamination (For Lightweight Soil Mixes) Test for physical and chemical composition, and saturated weight per cu.ft.
6. Planting operations shall not commence until the results of the Agronomic Soil Fertility Analysis and Recommendations are reviewed accordingly by the Landscape Architect.
7. The quantity or type of amendments may be modified by the Landscape Architect within fourteen (14) days of receipt of the results. The Agronomic Soil Fertility Analysis and Recommendations shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.
8. The Agronomic Soil Fertility Report/Recommendation shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.

1.4 SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Product/Material Data: Submit available product/material literature supplied by manufacturer’s, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.

a. Planting Soil (Imported/Amended Topsoil).
b. Soil Amendments (for each type used, for Sand, Perlite, Peat Humus, Gypsum, Soil Sulfur, Iron, etc).
c. Bulk Composted Organic Soil Amendment Material.
d. Granular Soil Conditioning Material.

e. Mycorrhizal Inoculum.
f. Fertilizers (for each type used).

2. Agronomic Soil Fertility Analysis and Recommendations: Submit a minimum of fourteen (14) days prior to amending of the soil and ordering soil amendments. The locations of where each of the soil test samples were derived from the Project Site shall be keyed to the site plan and shall be included with the results.
3. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar installations.

C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):

1. Provide Material Sample sets for each item submitted under Product/Material Data.

D. Submittals under this Article will be rejected without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.

E. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver and install materials so as to not delay Work and install only after preparations for installation have been completed.

B. Packaged Materials Deliver packaged materials in original, unopened packages or containers, with manufacturer's labels intact and legible, showing weight, analysis, and name of manufacturer. Store and secure properly to prevent theft or damage.

1. Store packaged materials off ground and under cover, away from damp surfaces and inclement weather.
2. Protect during storage and construction against soilage or contamination from earth and other materials.

C. Bulk Materials:

1. Deliver and store bulk materials so as not to impede Work of others.
2. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
3. Protect during storage and construction against soilage or contamination from earth and other materials. Provide adequate separation between bulk materials so as not to cross-contaminate bulk materials.
4. Store under cover, away from inclement weather.

5. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
6. Do not move or handle materials when they are wet or frozen.
7. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates. Furnish original certificates to Landscape Architect upon request.

1.6 COORDINATION, SCHEDULING, AND OBSERVATIONS

A. Notify the Contractors performing Work related to installation of Work under this Section in ample time to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.

B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.

C. Excavation: When conditions detrimental to adequate Soil Preparation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.

D. Installation: Perform Soil Preparation operations only when weather and soil conditions are suitable in accordance with locally accepted practices.

E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site, all associated cost are to be paid by the contractor.

1.7 SITE CONDITIONS

A. Project Site shall be free of weeds, native grasses, evasive grasses, (Bermuda Grass, Johnson Grass, Nut Grass, etc.) prior to Topsoil distribution or soil amendment placement.

B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated throughout the duration of the Project shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect.

C. Grading and soil preparation Work shall be performed only during the period when beneficial and optimum horticultural results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, spreading and grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.

1. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect.
2. If the soil moisture level is found to be insufficient for planting, planting pits shall be filled with water and allowed to drain before commencing planting operations.

D. Planting areas which become compacted in excess of 85% relative compaction due to construction activities shall be tilled and thoroughly cross-ripped to a minimum depth of twelve-inches (12”) to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

PART 2 - PRODUCTS

2.1 PLANTING SOIL (TOPSOIL)

A. Topsoil: Meet ASTM D5268, pH range of 5.5 to 7, 4 percent organic material minimum.

1. Topsoil Source: Reuse native surface soil stockpiled on the site. Verify suitability of native surface soil stockpiled on site to produce Topsoil meeting requirements; amend, as necessary. Supplement native surface soil stockpiled on site with imported Topsoil when quantities are insufficient.

    a. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over one-inch (1”) diameter or larger in any dimension sticks, oils, chemicals, plaster, concrete, roots, plants, sod, and other deleterious or extraneous materials harmful to plant growth.
    b. Obtain an Agronomic Soil Fertility Report/Recommendation of the stockpiled Topsoil from the approved Testing Laboratory indicated herein this Section.
    c. Test Results: Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Amend as required.

2. Topsoil Source Provide Imported Topsoil obtained from off-site sources, from naturally well-drained sites do not obtain from bogs or marshes.

    a. Quantity: Provide Imported Topsoil as soon as an insufficient quantity of native stockpiled surface soil is verified. Quantity of Imported Topsoil to complete the Work shall be calculated by Contractor
    b. Stockpiling: Stockpile on site as directed by Owner.
    c. Composition: To match in quality, accepted native stockpiled Topsoil.
    d. Analysis: Obtain an Agronomic Soil Fertility Report/Recommendation of the Imported Topsoil from the approved Testing Laboratory indicated herein this Section.
    e. Review: Landscape Architect reserves the right to take samples of the Imported Topsoil delivered to the site for conformance to the Contract Specifications.
    f. Rejected Imported Topsoil: Immediately remove rejected Imported Topsoil off site, at Contractor's expense.

2.2 SOIL MIXES/BLENDS (BACKFILL/PLANTING MIX)

A. Soil Conditioner Blend, for amending on-site native soil planting surfaces, stockpiled, plant back fill or imported topsoil: Furnish a thoroughly blended composition of Bulk Composted Organic Soil Amendment Material and Granular Soil Conditioning Material & Fertilizer. Any substitution for the "Soil Conditioner Blend" listed herein must be requested by the Contractor and approved, in writing, by the Landscape Architect at least thirty (30) days prior to installation.

1. Bulk Composted Organic Soil Amendment Material:

a. Material Composition: Bulk Composted Organic Soil Amendment Material shall be thoroughly cured for a minimum of 100 days, and shall be free from any trash (glass, metal, plastic, etc.) deleterious materials, bio-solids, and/or toxic chemicals. The Material shall be non-hazardous, and conform to US Environmental Protection Agency 40 CFR503 criteria for "Class A" products. It shall also exceed standards and specifications for unrestricted application as a landscaping and agricultural soil amendment.

b. Humus material shall have an acid-soluble ash content of no less than 6% and no more than 20%. The organic matter content shall be at least 50% on a dry weight basis.

c. Types of acceptable products are composts, manures, mushroom composts, straw, alfalfa, peat mosses etc. low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.

d. Composted wood products are conditionally acceptable . Wood based products are not acceptable which are based on red wood or cedar.

e. Sludge-based materials are not acceptable.

1) Gradation/Screen Analysis: A minimum of 90% of the material by weight shall pass a ½" screen. Material passing the screen shall meet the following criteria: Percent Passing Sieve Designation 80 – 100% 6.35 mm (1/4") 50 – 80% 2.38 mm (No.8) 0 – 40% 500 micron (No.35)

2) Maturity: Physical characteristics suggestive of maturity include shall include:

a) Color: Dark brown to black.

b) Odor: Aerobic, without malodorous presence of decomposition products.

c) Particle characterization: Identifiable wood pieces are acceptable, but the balance of Material should be soil-like without recognizable grass or leaves.

d) Analytical Properties: Contractor shall submit proof of the Bulk Composted Organic Soil Amendment Material by providing a sample as identified herein this Section, and a lab analysis that has been performed within 30 days of the installation of the planting. Soil mix shall have (at a minimum) the following properties: Material Minimum Targeted Property/Range Total Nitrogen (N%) .50-1.0% Phosphorus (as P2O5) 2.0% Potassium (as K2O) 0.2% pH (units) 6.0 to 7.5, as determined in saturated paste. Organic Content Minimum 50% based on dry weight and determined

by ash method. Minimum 205 lbs. organic matter per cubic yard of compost. ECe (millimho/cm) 5.0; based on pre-leaching with equal volume of water. Carbon-to-Nitrogen Ratio 25-to-1, nitrogen stabilized. Bulk Density 1,000 to 1,100 pounds/cubic yard. Sodium Absorption Ratio (SAR) Under 20.0 Total Iron 1.5% - 3.0% Moisture Content 35%-60% Acid-soluable Ash content No less than 6% and no greater than 20%. Salt Content 10millimho/cm @ 25d C. on a saturated paste extract. Boron Content 1.0 parts per million on a saturated paste extract. Silicon-Content (acid-insoluable ash) 50% Calcium Carbonate No presence on alkaline soils. Maximum Total Permissible Pollutant Concentrations Parts per million (mg/kg dry-weight basis) • Arsenic: 1.0 • Cadmium: 1.0 • Chromium: 10.0 • Cobalt: 2.0 • Copper: 1.0 • Lead: 30.0 • Mercury: 1.0 • Molybdenum: 2.0 • Nickel: 5.0 • Selenium: 1.0 • Silver: 0.5 • Vanadium: 3.0 • Zinc: 2.0

e) Application Rate: As indicated herein this Section under "Planting Soil Amendments Schedule".

f) Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

3) Provide submittal and sample to be approved by the Landscape Architect

2. Granular Soil Conditioning Material & Fertilizer:

a. Material Composition and Analytical Properties: Granular Soil Conditioning Material & Fertilizer shall be a singular manufacturer-blended combination of soil conditioning material and fertilizer. It shall be granular in form, long-lasting, free flowing, and suitable for application with approved equipment. It shall not contain any sewage sludge or manure-based products, and shall contain the following guaranteed minimum available analysis range: Element/Material Targeted Property Range Nitrogen (N) 5.0% to 6.0% Phosphoric Acid (as P2O5) 2.0% to 3.0% Potash (as K2O) 1.0% to 4.0% Humic Acids 15.0 % to 20.0% Calcium 7.0% Sulfur 0.0% to 5.0%

b. Commercial-Grade Products, Manufacturers and Associated Rates of Application: Subject to compliance with requirements.

1) Provide submittal and sample to be approved by the Landscape Architect.

B. Washed Plaster Sand: Clean, washed, natural or manufactured sand, sharp, fine-textured, free of toxic materials. Sieve tested in accordance with ASTM C136, with 100% passing through a #4 screen, 0% passing through a #200 screen.

1. Chemical Properties: (by DPTA Saturation Extract Method):

a. Soluble Salts/Salinity: Maximum conductivity of 3.0 millimhos/cm at 25 degrees C.

b. Boron: Maximum concentration of 1.0 PPM.

c. Sodium Absorption Ratio (SAR): Maximum 6.0.

d. pH: 7.0.

C. Perlite: Horticultural Perlite, soil amendment grade, 6.5 to 7.5 pH.

1. Unacceptable Materials: Polystyrene beads shall not be used as a substitution for horticultural Perlite.

D. Vermiculite: Horticultural Vermiculite, gold-brown in color.

1. Size: 2-4mm, 5 mesh to 10 mesh sieve size.
2. Density: 4.5 to 5.5 lb./cu ft.
3. Grade: #2, Medium Grade.

2.3 INORGANIC SOIL AMENDMENTS

A. Peat Humus:

1. Type: Canadian Sphagnum Peat, as derived from the genus Sphagnum, medium-divided, coarse fibrous texture, brown in color.
2. Measurement: Measure peat in air dry condition, containing not more than 35% moisture by weight on an "as-received" basis.
3. Physical Properties: Percent Passing Sieve Designation 95 – 100% 9.51 mm (3/8”) 0 – 40% 500 micron (No.35)
4. Organic Content (dry weight basis): Minimum 95%.
5. Fiber Content: Greater than 66%.
6. Water Holding Capacity: 20x to 30x its dry weight in water.
7. Range in Ash Content (%): 1.0 to 5.0.
8. Chemical Properties:

a. Nitrogen (dry weight basis): 0.6-3.0%.
b. Salinity/Soluble Salts: Saturation extract conductivity 0.0-3.0 millimhos/cm @ 25 degrees C.
c. pH range: 3.0 to 4.0.

9. Unacceptable Materials:

a. Coir Dust.
b. Sedge Peat.
c. Reed Peat.
d. Hypnum Peat.

B. Mycorrhizal Inoculum

1. Mycorrhizal Inoculum for Plant Material: Dual soil-conditioning biological inoculum system of endo-and ecto- Mycorrhizal, used to further aid the plants ability to efficiently uptake available soil nutrients and increase resistance to drought.

a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1) 7-gram Myco-Pak, Tri-C Enterprises LLC, Chino, CA, 800-927-

3311.
2) 4 oz. Packet - Roots 1 Step, Roots, Inc., Independence, MO, 800-342-6173.
3) Or equal, as approved by the Landscape Architect.

b. Provide at the prescribed application rate, per the Manufacturer's written recommendations.

2.4 CHEMICAL SOIL AMENDMENT COMPONENTS

A. General: Chemical Soil Amendment Components listed herein may or may not be used, depending on the results of the Agronomic Soil Fertility Report. Provide as required.

B. Gypsum: Commercially-processed and packaged agricultural-grade hydrated calcium sulfate product (CaSO4), 92.0% minimum, pH at 7.1.

1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

a. Ben Franklin® No. 1 Agricultural Gypsum, U.S. Gypsum Company.
b. 100% Good Stuff Gypsum™, Art Wilson Company.
c. CAL-SUL® Pelletized Agricultural Gypsum, North Pacific Group.
d. Bumper Harvest Agricultural Gypsum, Domtar Gypsum.
e. Premium 97 Solution-Grade Gypsum, Diamond K, Inc.
f. Or equal, as approved by the Landscape Architect.

C. Soil Sulfur: Elemental Sulfur (90% min.) commercially manufactured, water degradable, palletized.

1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

a. Disper-Sul, Martin Resources, Inc.
b. Soil Sulfur, Red Top.
c. Or equal, as approved by the Landscape Architect.

D. Iron: Non-staining, 40% Fe minimum, complete with micro-nutrients and 2% humic acids, as derived from iron oxide, manganese oxide, or zinc oxide.

1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the follo

a. Gro-Power Iron, Gro-Power, Chino, CA.
b. Iron 45 w/ Micronutrients, Tri-C Enterprises LLC, Chino, CA.
c. Or equal, as approved by the Landscape Architect.

E. Dolomite Lime: Agricultural-grade mineral soil conditioner containing 35% minimum magnesium carbonate, and 49% minimum calcium carbonate, 100% passing #65 sieve.

F. Potassium Sulfate (Sulfate of Potash K2O), (0 guaranteed analysis N-P2O5-K2O): Agricultural-grade, containing minimum 50% of water-soluble potash and 18% Sulfur (S).

G. Single Superphosphate P2O5 (0 guaranteed analysis N-P2O5-K2O): Commercial product, containing 15% available phosphoric acid and 14% Sulfur.

H. Triple Superphosphate P2O5, (0 guaranteed analysis N-P2O5-K2O): Commercial product, containing 45% available phosphate and 15% Calcium (Ca).

I. Ammonium Sulfate (NH4)2SO4, (21 guaranteed analysis N-P2O5-K2O): Commercial product containing approximately 21% ammonia.

J. Ammonium Nitrate NH4NO3, (34 guaranteed analysis N-P2O5-K2O): Commercial product containing approximately 34% ammonia.

K. Calcium Nitrate CaNO3, (15.5 guaranteed analysis N-P2O5-K2O): Agricultural grade containing 15-1/2% nitrogen.

L. Potassium Nitrate KNO3, (13 guaranteed analysis N-P2O5-K2O): Commercial product containing approximately 13% nitrogen and 45% potassium.

M. Ureaformaldehyde (38 guaranteed analysis N-P2O5-K2O): Granular commercial product containing approximately 38% nitrogen.

N. Urea CO(NH2)2, (46 guaranteed analysis N-P2O5-K2O): Granular commercial product containing 46% nitrogen

O. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing 31% nitrogen.

2.5 FERTILIZERS

A. Composition: Nitrogen (N), phosphorous (P2O5), and potassium (K2O) content, plus other elements, as indicated.

B. Fertilizer Tablet:

1. General: Fertilizer Tablet shall be a 7-gram tablet, organic-based, tightly compressed chip-type commercial grade, 12-month slow-release planting tablets, and shall be composed of the following available percentages by weight of plant food: Element/Material Targeted Property Range Nitrogen (N) 12% Minimum Phosphoric Acid (as P2O5) 8% Minimum Potash (as K2O) 8% Minimum Humus 20% Minimum Humic Acids w/ micronutrients and soil enhancers 4% Minimum
2. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

    a. Gro-Power 12 Planting Tablets, Gro-Power.

        1) Application Rate: As indicated herein Part III this Section.

    b. Or equal, as approved by the Landscape Architect.

2.6 ACCESSORIES

A. Drain Rock/Aggregate: Crushed Stone, conforming to ASTM C33, graded to ¾”-size,

clean, hard, durable, free of materials toxic to plant growth, set in bottom of Planters, at depth indicated in Contract Drawings. Provide Geotextile Filter Fabric between Drain Rock/Aggregate and amended planting backfill soil.

B. Wetting Agent/Water Storing Polymer: Non-biodegradable, granular, polyacrylamide polymer soil amendment.

1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, approved through submittal.

C. Landscape Mulch Material:

1. Organic Wood Mulch: Triple Hammered Hardwood Mulch
2. Rock Mulch: Crowley's Ridge Drainage Rock. Refer to plans for size.
3. Crushed Limestone: Refer to plans for size.

PART 3 - EXECUTION

3.1 ARGONOMIC SOIL FERTILITY REPORT/RECOMMENDATION

A. Once rough grading has been accomplished, and prior to commencing Soil Preparation operations, (amendments, fertilizers, etc.), soil samples shall be taken from representative areas and below grade depths of the Project Site. Locations and depths to gather the representative soil samples shall be accomplished by the Contractor under the direction of the Landscape Architect.

1. Provide a minimum of ten (10) Soil Samples from locations to be coordinated.

B. Guidelines for Selecting the Soil Samples:

1. Select representative areas to sample. The area needs to be uniform in color, texture, depth, and drainage with the same fertilizing program and type of use. Planting areas to receive lawns, flowerbeds, trees, cut areas, fill areas, etc. should be tested separately. An area containing multiple trees and shrubs can be grouped into one area if the planting is the same.
2. Depths and process of soil sampling:

a. Sample as deep as the soil will be amended, generally six-inches (6”) deep for groundcover/lawns, eighteen-inches (18”) deep for shrub areas, twenty-four-inches (24”) deep for small boxed trees, and three-feet (3’) to four-feet (4’) for large boxed trees.
b. Use a soil probe or soil auger to remove a core sample; otherwise, use a shovel to dig a hole to the desired depth. Sample the soil from the side of the excavated hole, scraping the side with a trowel. The tools used for digging shall be clean and not rusty. Avoid sampling when the soil is too wet.

3. In desired areas where multiple sub-samplings are taken from any one (1) area to create a combined sample, mix the sub-samples homogenously together in a clean plastic bucket prior to placing in the plastic bag.
4. Each Sample shall be sent directly to the laboratory in a separate, re-sealable, one

(1)-gallon plastic bag. Provide a minimum of four (4) cups of soil within each respective sample to allow for adequate testing.

3.2 SOIL PERCOLATION TESTING

A. Type/Quantity: During operations of Agronomic Soil Fertility Testing and prior to installing Plant Material, Contractor shall perform Soil Percolation Tests, through the direction of the Landscape Architect, in selected representative areas of the Project Site, to verify acceptable natural drainage, soil structure, and soil composition. Contractor shall verify the locations of the Soil Percolation Tests with the Landscape Architect

1. Required Number of Soil Percolation Tests: ten (10)

B. Procedure: Each Soil Percolation Test shall be performed as follows:

1. Dig a hole: 2’-0” wide x 2’-0” long x 2’-0” deep.
2. Fill the hole with water to top and cover with plywood and barricade. Allow hole to drain and fill again to top.
3. Make daily observations, noting the depth of water each day.
4. Report findings, in writing, to the Landscape Architect. Include the length of time the water takes to drain completely from each hole, date of test, location, and other information, which may be useful in providing further recommendations.

C. Results: Based on the combined results of the Agronomic Soil Fertility Testing and the Soil Percolation Tests, Contractor may be required to install additional tree drainage sumps or other drainage methods at each planting pit for trees larger than 15-gallon container stock. Contractor shall include, as a line-item price within the Base Bid, the price per each additional tree drainage sump, should they be required (based on the testing).

3.3 SOIL MOISTURE CONTENT

A. General: Do not work soil when moisture content is so great that excessive compaction occurs, or when it is so dry that dust will form in air, or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be the judgment of the Landscape Architect. Range: Maintain within tw

3.4 CLEARING, CULITIVATION, & EXCAVATION

A. Clearing: Clear planting areas free of stones two-inches (2”) in diameter and larger, weeds, debris, and other extraneous materials prior to soil preparation Work.

B. Pre-Plant Weed Control:

1. Clear and remove existing weeds by spraying and grubbing to at least one-inch (1”) below the soil surface.
2. Dead weeds shall be cleared and removed prior to planting

3. Maintain a weed-free Project Site until final acceptance by the Owner, utilizing mechanical, chemical, or manual treatment.

C. Cultivation of Native Site, with Amendments/Fertilizers:

1. Verification: In planting areas where Native Topsoil blend will be applied, verify that sub-grades prior to installation of Topsoil have been established under rough grading. Do not spread Topsoil prior to acceptance of sub-grade Work.
2. Cultivation: Following Pre-Plant Weed Control operations, rip or cultivate verified planting areas of Native Site Soil at the indicated depth, prior to applying Imported Topsoil (if required) and Soil Amendments/Fertilizers.

    a. Depth of Cultivation for existing soils: As specified in Drawings or minimum 8-inches (8”).
    b. Depth of Excavation for imported soils: As specified in Drawings or minimum 8-inches (8”).

3. Following initial cultivation or excavation of existing Native Site Soil, evenly spread Imported Topsoil (if required) throughout all planting areas at the minimum indicated depth to meet finished landscape grades.

    a. Minimum of eight-inch (8”) at Landscape Beds or Mass Planting areas.
    b. Minimum of four-inches (4”) at Sodded areas.
    c. Minimum of two-inches (2") at Permanent Seeded and Hydroseeded areas.

4. Once Imported Topsoil has been spread, uniformly broadcast all required Soil Amendments and Fertilizers as recommended through the results of the Agronomic Soil Fertility Report.
5. Thoroughly cultivate/blend all materials to provide a homogenous planting soil mixture at the indicated depth:

    a. Depth of Cultivation: Minimum eight-inches (8”).

6. Lightly tamp/compact prepared Planting Soil to eliminate settlement, and complete finish grading operations.
7. Planting Soil Amendment Schedule: The Planting Soil Amendment Schedule shall be based on the combined results of the Agronomic Soil Fertility Tests and Percolation Tests and recommendations provided by the Testing Agency/Lab.

3.5 APPLICATION RATES

A. Fertilizer Tablets shall be spread equidistantly around the perimeter within the Amended Planting Backfill Mixture, up to within three-inches (3”) of the finished grade of the Mixture, and at the following rates: Size of Plant Material Total Quantity of 7-gram tablets One (1)-gallon Container stock. One (1) Tablet Five (5)-gallon Container stock. Nine (6) Tablets Fifteen (15)-gallon container stock Fifteen (10) Tablets 2.5” Caliper Stock Fifteen (15) Tablets 3”-4” Caliper Stock Twenty

1. Contractor shall not provide Fertilizer Tablets for designated native plant species, if directed by the Landscape Architect. Contractor shall verify with the Landscape Architect, in writing, as to which plants are subject to not receive the Fertilizer Tablets.

B. Mycorrhizal Inoculum Application Rate:

1. During application of Fertilizer/Planting Tablets, Mycorrhizal Inoculum shall be spread equidistantly around the perimeter within the Amended Planting Backfill Mixture, up to within three (3”) inches of the finished grade of the Mixture, at the prescribed application rate per the Manufacturer’s written recommendations.

3.6 DRAINAGE OF PLANTING AREAS

A. Surface Drainage:

1. Discrepancies: Provide proper surface drainage of planted areas. Submit in writing all discrepancies in the Contract Drawings or Specifications, or prior Work done by others, which Contractor feels precludes establishing proper drainage.
2. Correction: Include description of work required for correction or relief of said condition

B. Detrimental Drainage, Soils and Obstructions:

1. Notification: Submit in writing all soils or drainage conditions considered detrimental to growth of plant materials. State condition and submit proposal and cost estimate for correcting condition.
2. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with Work.
3. Obstructions: If rock, underground construction Work, tree roots, or other obstructions are encountered in the performance of Work under this Section, submit cost required to remove the obstructions to a depth of not less than six-inches (6”) below the required soil depth.

3.7 MAINTENANCE

A. Protect graded areas from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded, and damaged areas.

B. Where completed areas are disturbed by construction operations or adverse weather, scarify surface, reshape, and compact to required density.

3.8 WASTE MATERIALS

A. Haul from site and legally dispose of waste materials including trash and debris as required and approved by the owner typical.

3.9 CLEAN UP

A. Upon completion of filling and grading work, remove equipment and tools. Leave site clear, clean, free of debris and ready for subsequent trades work.

END OF SECTION

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide sodded lawns as shown and specified. The work includes:

1. Soil Preparation
2. Sodding lawns and other indicated areas.
3. Maintenance.

1.2 QUALITY ASSURANCE

A. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.

B. Provide and pay for materials testing. Testing agency shall be acceptable to the Architect. Provide the following data:

1. Test representative materials samples proposed for use.
2. Topsoil:

a. pH factor.
b. Mechanical analysis.
c. Percentage of organic content.
d. Recommendations of type and quantity of additives required to establish satis-factory pH factor and supply of nutri¬ents to bring nutrients to satisfactory level for planting.

1.3 INFORMATIONAL SUBMITTALS

A. Submit sod growers certification of grass species. Identify source location.

B. Submit the following materials certification:

1. Fertilizer(s) analysis.

C. Submit materials test report.

D. Upon sodded lawn acceptance, submit written maintenance instructions recommending procedures for maintenance of sodded lawns.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Cut, deliver, and install sod within a 24-hour period.

1. Do not harvest or transport sod when moisture content may adversely affect sod

survival.
2. Protect sod from sun, wind, and dehydration prior to installation.
3. Do not tear, stretch, or drop sod during handling and installation.

1.5 FIELD CONDITIONS

A. Work notification: Notify Architect at least 7 working days prior to start of sodding operations.

B. Protect existing utilities, paving, and other facilities from damage caused by sodding operations.

C. Perform sodding work only after planting and other work affecting ground surface has been completed.

D. Restrict traffic from lawn areas until grass is established. Erect signs and barriers as required.

E. Provide hoses and lawn watering equipment as required.

1.6 WARRANTY

A. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas until final acceptance. Re sod areas, with specified materials, which fail to provide a uniform stand of grass until all affected areas are accepted by the Landscape Architect.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Reference plan for turf material type.

B. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable grasses, stones, roots, thatch, and extraneous material; viable and capable of growth and development when planted.

C. Fertilizer:

1. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.

a. Fertilizer with a ratio of 20 for establishing sod areas.
b. Fertilizer with a ratio of 30 for maintaining the lawn.

D. Water: may not be available on site. Landscape contractor will provide necessary hoses and other watering equipment required to maintain and complete work. An automatic/drip irrigation system will be installed simultaneously with the landscape planting. The landscape contractor shall not anticipate the use of the irrigation system

during installation of this contract.

E. Lime: Apply appropriate rate of pelleted lime as the pH test indicates. No lime is needed if the pH test is between 6.0-7.0.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine finish surfaces, grades, topsoil quality, and depth. Do not start sodding work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Limit preparation to areas which will be immediately sodded.

B. Loosen topsoil of lawn areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish, and extraneous matter.

C. Grade lawn areas to smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake; remove ridges and fill depressions as required to drain.

D. Apply Type A fertilizer at the rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. (220 lbs./acre). Apply fertilizer by mechanical rotary or drop type distributor, thoroughly and evenly incorporated with the soil to a depth of 3" by disking or other approved methods. Fertilize areas inaccessible to power equipment with hand tools and incorporate it into soil. Buffalo Grass Sod may not require fertilizer submit soil test for review by Landscape Architect.

E. Dampen dry soil prior to sodding.

F. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to sodding.

3.3 INSTALLATION

A. Sodding:

1. Lay sod per plans to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.
2. Do not lay dormant sod or install sod on saturated or frozen soil.
3. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row.
4. Peg sod on slopes greater than 3 to 1 to prevent slippage at a rate of 2 stakes per yd. of sod.

5. Water sod thoroughly with a fine spray immediately after laying.
6. Roll with light lawn roller to ensure contact with sub-grade.

B. Sod indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction operations.

3.4 MAINTENANCE

A. Maintain sodded lawn areas, including watering, spot weeding, mowing, application of herbicides, fungicides, insecticides and resodding until a full, uniform stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Architect at the completion and acceptance of the entire project.

1. Water sod thoroughly every 2 to 3 days, or as required to establish proper rooting.
2. Repair, rework, and resod all areas that have washed out or are eroded. Replace undesirable or dead areas with new sod.
3. Mow lawn areas as soon as lawn top growth reaches a 3" height. Cut back to 2" height. Repeat mowing as required to maintain specified height. Not more than 40% of grass leaf shall be removed at any single mowing.
4. Apply Type B fertilizer to lawns approximately 30 days after sodding at a rate equal to 2.0 lbs. of actual nitrogen per 1,000 sq. ft. (140 lbs./acre). Apply with a mechanical rotary or drop type distributor. Thoroughly water into soil. *Only as required per soil test for Buffalo Sod
5. Apply herbicides as required to control weed growth or undesirable grass species.
6. Apply fungicides and insecticides as required to control diseases and insects

3.5 ACCEPTANCE

A. Inspection to determine acceptance of sodded lawns will be made by the Architect, upon contractor's request at the completion of the entire project. Provide notification at least 10 working days before required inspection date.

1. Sodded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, even colored viable lawn is established, free of weeds, undesirable grass species, disease, and insects.

B. Upon final acceptance, the Owner will assume lawn maintenance.

3.6 CLEANUP AND PROTECTION

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from sodding operations.

END OF SECTION

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide trees, shrubs, ground covers, native perennials, native grasses and native wildflower and grass seed as shown and specified.

1. Soil preparation.
2. Trees, shrubs, groundcovers, native perennials and native grasses.
3. Mulch and planting accessories.
4. Maintenance and Extended Management.

B. Related Requirements:

1. Section 015713 "Temporary Erosion and Sediment Control"
2. Section 328400 "Landscape Irrigation Performance Specification" for complete irrigation systems.
3. Section 329200 "Turf and Grasses" for turf (lawn) and erosion-control materials.
4. Section 329400 "Soil Preparation"

C. Definitions:

1. Plant Material(s) – Refers to living plant species, inclusive of trees, shrubs, groundcovers, vines, ornamental grasses, cacti/succulents, espaliers, annuals, perennials, etc., as indicated in the Contract Drawings.
2. Planting Area (PA) – As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
3. Plant Height – Measurement of main body height, not measurement to branch tip.
4. Plant Spread – Measurement of main body diameter, not measurement from branch tip to branch tip.
5. Amended Planting Backfill Mixture – Refer to Section 32 91 13 – Soil Preparation.
6. Balled and Burlapped Stock – Healthy, vigorous exterior plants with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
7. Balled and Potted Stock – Healthy, vigorous exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
8. Bare-Root Stock – Healthy, vigorous exterior plants grown with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
9. Compacted Settling Layer – Subgrade under where a plant is directly planted.
10. Container-Grown Stock – Healthy, vigorous, well-rooted exterior plants grown in

a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

11. Fabric Bag-Grown Stock – Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
12. Finish Grade – Elevation of finished surface of planting soil.
13. Manufactured Topsoil – Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
14. Multi-Stem – Where three (3) or more main stems arise from the ground from a single root crown or at a point right above the root crown.
15. Sub-grade – Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
16. Subsoil – All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

1.2 QUALITY ASSURANCE

A. Installer Qualifications:

1. Requirement: Valid Arkansas Landscaping Contractor License.
2. Engage an experienced Installer who has demonstrated completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
3. Installer's Field Supervision Installer shall maintain an experienced full-time supervisor on the Project site during times that landscaping installations under this Section are in progress.
4. Selections of Plant Material may be sourced and purchased by the Owner directly. Contractor to provide a line item installation cost and separate warranty identifying the schedule of values for each.

B. Plant Material:

1. Trees, Shrubs, Grasses and Seed: Provide quality, size, genus, species, and variety of Plant Material indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

    a. At least one (1) plant of each Plant Material species delivered to the Project Site shall have an identification tag from supplying nursery showing botanical and common name of the plant as identified in the Contract Drawings. Landscape Architect shall be provided the opportunity for an on-site debriefing by the Contractor that identifies the size and specific type of Plant Material upon delivery.

        1) Provide replacements equal to the size and quality to match the planted materials at the time the untrue species is discovered.

    b. Replace, at no cost to Owner, Plant Material that is revealed during the course of the Contract as to being untrue to the species indicated in the

Contract Drawings and reviewed accordingly under this Section.

c. Replacement of Plant Material: Refer to the Guarantee Article indicated herein this Section.

C. Plant Material Observation: Landscape 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. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

D. Regulatory Requirements:

1. Contractor shall meet the requirements of applicable laws, codes, and regulations as required by the authorities having jurisdiction over the Work. Plant names indicated, comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

E. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.

F. Plant Material Review and Selection (Tagging):

1. At the discretion of the Landscape Architect, Plant Material will be subject to review, photographed, and selected/tagged by the Landscape Architect at the nursery, or other place of growth, prior to delivery to the Project Site. Contractor shall verify with the Landscape Architect if tagging operations are required.
2. Selecting/Tagging of Plant Materials at the nursery or place of growth does not cancel the right of the Landscape Architect to reject Plant Materials at the Project Site, if damaged or unacceptable conditions are found that were not detected at the nursery, place of growth, or in the submitted photographs.

G. Plant Material Delivery: Plant Material shall be delivered with original Plant Material tagging materials set in place, as selected, and marked by the Landscape Architect at the nursery or place of growth. Seed, topdressing, and any fertilizer materials shall be delivered in original containers. Include materials showing weight, analysis, and names of growers. Store all seed material in a manner to prevent wetting, excessive heating, or other deterioration. Contractor shall notify Landscape Architect upon delivery of Plant Material for review of stock and tagging materials. Plant Materials delivered without original tagging materials, or with broken, damaged, or altered tagging materials, shall be subject to rejection by the Landscape Architect. Rejected Plant Material shall be removed immediately.

H. Pre-installation Conference: Conduct conference at Project Site.

I. Protection of Existing Plant Material:

1. Refer to Requirements specified in Section 015639 – Temporary Tree and Plant Protection.

2. It is the intent of the Contract Documents that certain existing Plant Materials shall be retained. Prior to the removal of any Plant Materials, the Contractor shall confer with the Landscape Architect to determine which Plant Materials are to remain.
3. All existing Plant Materials which are to remain in the project shall be tagged and identified by the Contractor prior to start of Work.
4. Contractor shall be responsible for Plant Materials that are designated to remain. Damage to any Plant Materials which results in death or permanent disfiguration of said Materials shall result in compensation outlined in Section 01 56 39 – Temporary Tree and Plant Protection. The Landscape Architect shall be the sole judge of the condition of the Plant Materials.
5. Existing Plant Materials designated to remain shall be protected at all times from damage by construction activity (tools, materials, equipment, personnel, etc.). Damage by the Contractor to existing Plant Materials shall be repaired at the Contractor's expense to the satisfaction of the Owner, as directed by the Landscape Architect.
6. Contractor shall insure that no foreign material and/or liquid, such as paint, concrete, cement, oil, turpentine, acid or the like, be deposited or allowed to be deposited on soil within the drip line (the outside edge of the foliage overhang) of any Plant Material. Do not store construction materials, debris, or excavated material within drip line of existing Plant Material. Should any such poisoning of the soil occur, the Contractor shall thoroughly remove said soil as directed by the Landscape Architect and replace with acceptable soil at no additional cost to the owner.
7. Excavation adjacent to existing Plant Materials: Where it is necessary to excavate in close proximity to the drip lines of existing Plant Materials, all possible caution shall be exercised to avoid injury to roots and trunk. Excavation close to Plant Materials shall be done by hand, with narrow-tine spading forks or other approved tools to comb soil to expose roots. Tunnel under roots two-inches (2") and larger in diameter. Cutting of roots two-inches (2") and larger shall be only on the approval of the Landscape Architect.
8. Replacement of Damaged Plant Material: Replace existing Plant Material to remain as required, hat are damaged by Contractor during construction with accepted Plant Material of the same species, size, and quantity as those damaged, at no additional cost to Owner. Owner shall be the sole judge as to the extent of the damage and the value of said damaged Plant Material.

1.3 SUBMITTALS

A. General

1. Collect information into a single submittal.
2. Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Alphabetized List of Plant Material.
2. Submitted in the following format.

    a. Project Name
    b. Botanical Name
    c. Common Name
    d. Container Size
    e. Overall Height
    f. Caliper Size
    g. Quantity

3. The submittal shall not be construed as to acceptance of the plant material. All plant material shall be subject to review and approval by the Landscape Architect upon delivery to the project site.

C. No work shall proceed under this Section until submittal requirements indicated herein have been review accordingly by the Landscape Architect.

D. Provide plant material record drawings:

1. Legibly mark drawings to record actual construction.
2. Indicate horizontal and vertical locations, referenced to permanent surface improvements.
3. Identify field changes of dimension and detail and changes made by Change Order.

E. Submit for the Landscape Architect's approval five samples of each container grown plant under the number 15 container size. The five approved samples shall be retained in a protected location on the project site at a location approved by the General Contractor. The Landscape Contractor shall maintain the sample plants until completion of the site planting. The sample plants may then be used in the site planting.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Do not prune Plant Material before delivery, except as approved by the Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie Plant Material in such a manner as to destroy natural shape.

1. Immediately after digging field-grown Plant Materials, pack root systems in wet straw, hay, burlap, or other suitable material to keep root system moist until final planting installation.
2. Deliver freshly dug field-grown Plant Materials with firm, natural balls of earth of sufficient depth to include fibrous and feeding roots, meeting, or exceeding requirements of ANSI Z60.1 for root ball diameter.
3. Store all seed material in a manner to prevent wetting, excessive heat, or other deterioration.

B. Handling Plant Materials:

1. Handle balled and burlap Plant Material stock by the root ball.
2. Handle container-grown Plant Materials only by their containers.

3. DO NOT handle Plant Materials by their trunks or stems.
4. DO NOT drop any Plant Materials.
5. DO NOT bind or handle Plant Materials with wire or rope.
6. Pad trunk and branches of Plant Materials whenever using hoisting cables, chains, or straps.
7. Should the Contractor engage in handling any Plant Material(s) by any unacceptable method(s), the Landscape Architect shall reserve the right to reject any of the mishandled Plant Material(s). The Contractor shall replace rejected Plant Material(s) with approved Plant Material(s), at no additional cost to the Owner.

C. Delivery: Provide protective covering during delivery. Deliver Plant Material only after preparations for planting have been completed and install immediately. If planting is delayed more than six (6) hours after delivery, set Plant Materials in shade, protect from weather and mechanical damage, and keep roots moist. Anchor plants to prevent damage from winds.

1. Heel-in bare-root Plant Material stock. Soak roots in water for two (2) hours prior to planting.
2. Set balled Plant Material stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. DO NOT remove container-grown Plant Material stock from containers before time of planting.
4. Water root systems of Plant Material stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.5 FIELD CONDITIONS

A. Work notification: Notify Architect at least 7 working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.

C. A complete list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern.

1.6 WARRANTY

A. Warrant plant material to remain alive and be in healthy, vigorous condition for a period of 1 year after completion and acceptance of entire project.

1. A review of plants will be made by the Architect at Substantial Completion and Final Completion.

B. Replace, in accordance with the drawings and specifications, all plants that are dead or, as determined by the Architect, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes such as bark abrasions and misuse of chemicals, due to the Landscape Contractor's negligence. The cost of such replacement(s) is at Landscape Contractor's expense. Warrant all replacement plants for

1 year after installation.

C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area, acts of vandalism or negligence on the part of the owner.

D. Remove and immediately replace all plants, as determined by the Architect, to be unsatisfactory during the initial planting installation.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. Immediately upon award of Contract for Work in this Section, Contractor shall locate and purchase or hold for purchase plant material as required.

1. Contractor shall verify with Landscape Architect of Plant Material that has been nursery "contract grown" by the Owner for use of Work under this Contract.
2. Contractor shall review the condition of the Plant Material with Landscape Architect at the nursery maintaining the Plant Material prior to delivery, and when delivered to the Project Site.

B. Quality: Plant Materials shall have a growth habit typical for each variety and species indicated in the Plant List (as detailed on the Contract Drawings).

1. All Plant Materials specified shall be superior/premium-grade nursery stock, full, densely foliated, symmetrical, with tightly knit branching, so trained or favored in development and appearance in form, number of branches, compactness and symmetry, healthy, and vigorous in growth, as reviewed and determined by the Landscape Architect
2. Plant Materials shall be free from insect pests, eggs and larvae, plant diseases, sun scalds, fresh bark abrasions, excessive abrasions, windburn, salt burn, weeds, or other disfigurements or conditions, as reviewed and determined by the Landscape Architect.
3. Plant Material shall be subject per the Arkansas State Department of Agriculture's Regulations for Nursery Inspections of Rules and Grading.
4. Growing Conditions: Plant Materials shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of project unless otherwise specifically authorized.

C. Container Stock (excluding annuals) shall be grown in boxes or containers in which delivered for at least one (1) growing season, but not over two (2) years. Plant Material grown in boxes or containers shall be cultivated during this time to permit full rooting within the specified box or container to bind the planting soil, but not so long as to create a "root-bound" condition.

1. Plant Material shall be completely free of circling, kinked or girdling trunk surface and center roots, and show no evidence of a pot-bound condition.
2. No boxed nor container Plant Material shall be planted which have cracked or broken balls of earth when separated from their boxes or containers.

3. No Plant Material shall be planted with damaged roots, broken root balls, or which are found to be “root-bound” when separated from their containers.

D. Pruning:

1. Do not prune Plant Materials unless directed by the Landscape Architect.
2. Pruning of Plant Material as grown at the nursery shall conform to ANSI A300 Standards.
3. Consult with Landscape Architect for pruning Plant Materials after delivery and installation.

E. Measurements: Measure Plant Material according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes.

1. Take caliper measurement at a point on the trunk six-inches (6”) above natural ground line for trees up to four-inches (4”) in caliper (at a point twelve-inches (12”) above the natural ground line for trees over four-inches (4”) in caliper).

    a. Measure foliage across mean foliage dimension when branches are in their normal upright position.
    b. For trees to be supplied in “raised up” condition, foliage origin along main trunk shall be measured from soil line after installation.
    c. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Properly trimmed plants shall measure the same in any direction. If a plant is unevenly grown, it shall be classified in the size category of the smallest dimension.

2. Size Range: If a range of size is given, do not use Plant Materials less than the minimum size. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plant Materials that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.

F. Field Dug Stock: Prior to digging of field-grown Plant Materials, ensure that excess loose fill resulting from cultivation around trunks/stems and over roots be removed down to natural finish grade at crown of Plant Materials. During digging, verify that size of tree spade or other equipment is adequate to encompass the actively growing root zone of all Plant Materials. Plant Materials which, after digging, show mostly large fleshy roots and few fibrous roots, will be rejected.

G. Condition of Root Systems: Plant Materials must prove to be completely free of circling, kinked or girdling trunk surface and center roots and show no evidence of a root-bound condition. Upon inspection by Landscape Architect at the job site, if five-percent (5%) or more of the plants of each species are found to contain kinked, circling or girdling roots, all plants of that species shall be rejected.

H. Unacceptable Trees: Trees that have damaged, broken, pruned, or crooked leaders will be rejected. Trees having a main leader shall not have been headed back. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 3/4 in. which have not completely callused will be rejected.

2.2 TREES

A. Shade and Flowering Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitation for container stock.

1. Branching Height: 1/2 of tree height, unless otherwise indicated on Contract Drawings.

B. Small Trees: Small upright or spreading type, branched, or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitation for container stock.

1. Form: As indicated on the Contract Drawings for individual selected species.

C. Field Dug Specimen Trees:

1. Form and Size: As specified on the Contract Documents for height, spread, and/or caliper, subject to review and acceptance by the Landscape Architect at the supplying nursery prior to delivery and installation. Provide superior quality, full, symmetrical, well-rooted, upright, spreading, with well-balanced crown.
2. Throughout the duration of excavation, transport, delivery, storage, and installation, all Field Dug Specimen Trees shall have their root balls remain moist, firm and intact, with no damage. Provide metal cages, as required, to insure root ball stability. Any tree that exhibits a broken, damaged, or dry root ball at any time under the Contract shall be subject to immediate rejection by the Landscape Architect.

2.3 SHRUBS

A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of Shrub, subject to review and acceptance by the Landscape Architect. Container-grown Shrubs will be acceptable in lieu of balled and burlapped.

1. Container-grown Shrubs shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

2.4 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, well-rooted , broadleaf evergreens, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.

1. Container-grown broadleaf evergreens shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

2.5 GROUNDCOVERS

A. Provide ground covers full, established, and well-rooted in removable flats, containers, or integral peat pots, and with not less than the minimum number and length of runners required by ANSI Z60.1 for the container size indicated, and other requirements as indicated on the Contract Drawings, subject to review and acceptance by the Landscape Architect.

2.6 NATIVE GRASSES AND PLUGS

A. Form and Size: High-quality, established, full, well-balanced, well-rooted, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.

1. Container-grown stock shall be subject to meeting ANSI Z60.1 limitations for container stock.

2.7 PLANT LIST

A. The plant list including quantities is located on the plans and is for reference only. It is the responsibility of the contractor to determine total quantities in conformance with the plans. Height of plants specified and height of lowest branches of trees is above soil line.

PART 3 - EXECUTION

3.1 INSPECTION

A. No work under this section shall commence until submittals under this section have been reviewed accordingly by the Landscape Architect.

B. Prior to commencing Work under this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and to the point where Work herein may commence properly. Do not proceed with Work until unsatisfactory conditions have been corrected.

C. Installation practices of the Plant Materials shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practices, as judged by the Landscape Architect.

1. Soil moisture levels prior to planting shall be no less than seventy-five-percent (75%) of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect, and their decision shall be final.

a. If the soil moisture level is found to be insufficient for planting installation, planting pits shall be filled with water and allowed to drain before commencing planting operations.
b. Any planting area that may become compacted in excess of eighty-five-

percent (85%) relative compaction (due to construction operations or other activities during the Contract) shall be tilled and thoroughly cross-ripped to a minimum depth of nine-inches (9”) to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

c. Do not commence planting installation prior to acceptance of Section 329113 –Soil Preparation.

D. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.

E. Preparation of Planting Installation: Lay out individual Plant Material locations and areas for multiple plantings. Stake locations, outline areas, and gain the Landscape Architect’s acceptance prior to commencing physical planting installation.

F. At the discretion of the Landscape Architect, Contractor shall make field adjustments to the planting layout, as required, per the direction of the Landscape Architect. Layout changes made accordingly shall be performed at no additional cost to the Owner.

G. No more Plant Materials shall be distributed in the planting area on any day than can be installed and watered on that day. Plant Materials shall be planted and watered immediately after the removal of their containers, as applicable.

H. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and Landscape Establishment Period.

I. Finish Grades for planting areas shall have been established by the Landscape Contractor prior to Work under this Section. Verify that grades are within one-inch plus or minus (1”+/-) of the required finish grade, and that all proper soil amendments and fertilizers have been furnished and installed accordingly as specified (per Section 329113 – Soil Preparation).

1. Maintain positive surface drainage of all planted areas throughout the duration of the Contract.

J. Pre-Planting: Where Plant Materials are to be pre-planted to permit site improvements to be installed around them, Contractor shall be responsible for the accurate layout and placement of those Plant Materials, as measured to their centerlines. Confirm designated pre-planting operations with Landscape Architect prior to commencing Work. Contractor shall also be responsible for the protection of pre-planted Plant Materials while other Work is taking place around them. Provide automated irrigation, as necessary, prior to installation and functioning of irrigation systems (per Section 32 84 00 – Irrigation Systems).

3.2 EXCAVATION FOR PLANT MATERIALS

A. General: Upon completion of applicable pre-planting soil preparation requirements indicated in Section 32 91 13 – Soil Preparation, excavate planting hole(s) for Plant Material with scarified vertical sides, with the bottom of the excavated hole slightly raised and compacted at the center to assist drainage and to minimize settlement of the Plant Material. Excavate holes according to the spacing alignment (i.e. hedge spacing, grid spacing, triangular spacing, etc.) and the on-center (O.C.)

B. Planting areas that have not been excavated prior to planting.

1. Balled and Burlap Plant Material:

a. Excavate the planting hole to the width and depth indicated in the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is two-inch (2") higher than finished grade or as further directed by the Landscape Architect
b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.

2. Container-Grown Plant Material:

a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is two-inch (2") higher than finished grade or as further directed by the Landscape Architect:
b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.

3. Field Grown/Specimen Trees:

a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is three-inch (3") higher than finished grade or as further directed by the Landscape Architect
b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
c. In areas where special subsurface drainage for planting is indicated, tie drainage pipes, as required, into the drain system.
d. Excavate planting hole at 3x the diameter of the rootball.

C. Obstructions: Notify the Landscape Architect immediately if unexpected rock, debris, contaminants, obstructions, or other items that are detrimental to the healthy sustained growth of Plant Material is encountered in the excavation process.

1. Hardpan Layer: If encountered, drill six-inch (6") diameter holes into free-draining strata or to a depth of ten-feet (10'), whichever is less, and backfill with free-draining material.

D. Drainage: Notify the Landscape Architect if subsoil conditions show evidence of unexpected water seepage or retention in planting holes.

E. Time of planting:

1. Evergreen material: Plant evergreen materials between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at times, other than winter months, plants shall be sprayed with anti-desiccant prior to planting operations.
2. Deciduous material: Plant deciduous materials in a dormant condition. If

deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.

3.3 INSTALLATION

A. Balled and Burlapped Plant Material: Set the Balled and Burlapped Plant Material plumb and in center of the excavated hole, with top of the root ball raised above adjacent finish grade as indicated. Set Balled and Burlapped Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.

1. Carefully place the Balled and Burlapped Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set two-inch (2") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, handle the Plant Material by its root ball; avoid handling the Plant Material by its trunk.
2. Once orientation is accepted, carefully remove the burlap and wire baskets from the tops of the root ball and partially from the sides, but do not remove from under the root ball. Do not damage the root ball or any part of the plant. Plant Material shall be rejected if the root ball is cracked or broken before or during the planting operation.
3. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:

    a. ¼ yard of Bulk Composted Organic Soil Amendment Material (per Section 32 91 13 – Soil Preparation).
    b. ½ pound of Granular Soil Conditioning Material & Fertilizer (per Section 32 91 13– Soil Preparation).
    c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 32 91 13 –Soil Preparation), per the Manufacturer's latest printed instructions.

4. Backfilling the excavated planting hole:

    a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
    b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
    c. Add the Fertilizer Tablets and other amendments, (per Section 32 91 13 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
    d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball. Pull soil away and exposed root flare. Ensure root flare is planted above finished grade.
    e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole. Do not cover the top of the root ball with the backfill

mixture.

f. Thoroughly mix water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture. Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.

5. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to plans for type and requirements.
6. Wrapping:

   a. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.
   b. Wrap trunks of all trees as directed spirally from bottom to top with specified tree wrap and secure in place.
   c. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.
   d. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom.

7. Staking/guying:

   a. Stake/guy all trees immediately after each tree planting.
   b. Stake all trees and all multi-trunk trees.
   c. Flag or color all cables.
   d. All work shall be acceptable to the Landscape Architect.

B. Container-Grown and Ball and Burlap Plant Material: Set Plant Material plumb and in the center of the excavated planting hole, with top of the root ball raised above adjacent finish grade as indicated. Set Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.

1. For plastic container stock (4” pot, 1-gallon, 5-gallon, 15-gallon, etc.), carefully remove the plant container prior to setting the plant in the excavated hole so as not to damage root ball. Tip container to horizontal position and shake carefully to remove Plant Material. Support root ball during installation to prevent cracking or shedding of soil.
2. Set the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1”) above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the plant material, carefully handle the Plant Material by its container; avoid handling the Plant Material by its trunk.

   a. Plant Material with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.

3. For Ball and Burlap stock, carefully set whole root ball of the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set two-inch (2") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation, carefully handle the Plant Material by its basket; avoid handling the Plant Material by its trunk or branches. Once orientation is accepted, remove 1/3 of the wire basket so as not to damage the root ball or any part of the plant. Do not remove the bottom of the wire basket. Discard top 1/3, do not bend back or bury.

    a. Plant Material with a damaged root ball upon placing/planting, or if the root ball fails to thoroughly hold the soil as it is planted, or if the plant is mishandled or damaged during planting operations, shall be rejected.

4. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:

    a. ¼ yard of Bulk Composted Organic Soil Amendment Material (per Section 32 91 13 – Soil Preparation).
    b. ½ pound of Granular Soil Conditioning Material & Fertilizer (per Section 32 91 13– Soil Preparation).
    c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 32 91 13 –Soil Preparation), per the Manufacturer's latest printed instructions.

        1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.

            a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.

5. Backfilling the excavated planting hole:

    a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets. Foot tamp the backfill, as required.
    b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
    c. Add the Fertilizer Tablets and other amendments (per Section 32 91 13 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
    d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
    e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the

planting hole. Do not cover the top of the root ball with the backfill mixture.

6. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to drawings for type and requirements.
7. Wrapping:

    a. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.
    b. Wrap trunks of all trees as directed spirally from bottom to top with specified tree wrap and secure in place.
    c. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.
    d. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom.

8. Staking/guying:

    a. Stake/guy all trees immediately after each tree planting.
    b. Stake all trees and all multi-trunk trees.
    c. Flag or color all cables.
    d. All work shall be acceptable to the Landscape Architect.

3.4 PRUNING AND THINNING OF PLANT MATERIAL

A. Pruning/Thinning of Tree Canopy

1. At no time shall Plant Material be pruned, trimmed, thinned, shaped, or topped prior to delivery. Pruning, trimming, thinning, shaping, or topping of Plant Material shall be only conducted on the Project Site, and under the presence and direction of the Landscape Architect or approved Certified Arborist. Plant Material that has been pruned and delivered to the Project Site without prior approval by the Landscape Architect or an approved Certified Arborist will be rejected.

B. When directed by the Landscape Architect or an approved Certified Arborist, Contractor shall prune, thin, and shape plant material, according to standard horticultural practice, to preserve the natural character of the Plant Material.

1. Pruning and remedial work shall be done per ANSI A300.
2. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from trees.
3. Prune shrubs accordingly to retain natural character.
4. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.
5. Newly planted trees shall be pruned near the termination of the Landscape Establishment Period, per the direction of the Landscape Architect, as required.

3.5 CLEANING AND PROTECTION

A. During installation operations, keep Work area in an orderly and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, surplus soil and other items resulting from construction operations and legally dispose of it off the Owner's property.

D. Scars, ruts, or other marks in the ground caused by the Contractor's Work shall be repaired.

E. Remove equipment and implements of service and leave the entire Project Site area in a neat, clean, and Owner-approved condition.

F. Labels: Remove all nursery-type labels, flags, and or identification markings from Plant Materials AS DIRECTED BY THE Landscape Architect.

3.6 PLANT MAINTENANCE

A. Maintain the trees, shrubs, groundcovers, perennials, native grasses until Final Completion of the entire project. Upon Final Completion, the Owner will assume maintenance as recommended by the written maintenance instructions submitted by the Landscape Contractor for Sodded areas only.

B. 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, application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease, and performing other operations as required to establish healthy, viable plantings.

C. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.

D. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.

E. Deep-water trees, plants, groundcover, perennial and native grass beds within the first 24 hours of initial planting, and thereafter as required for healthy growth until final acceptance.

3.7 SUBSTANTIAL COMPLETION

A. An inspection of the trees, shrubs, groundcovers, perennials and native grasses will be made by the Landscape Architect upon request for Application of Substantial Completion by the Landscape Contractor. Provide notification of at least five (5)

working days before requested inspection date.

3.8 FINAL COMPLETION

A. An inspection of the trees, shrubs and ground covers will be made by the Landscape Architect upon request for Final Completion by the Landscape Contractor.

END OF SECTION

SECTION 329400 - HYDROSEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide seeded lawns as shown and specified. The work includes:

1. Soil preparation.
2. Hydroseeing
3. Maintenance.

1.2 QUALITY ASSURANCE

A. Provide and pay for materials testing. Testing agency shall be acceptable to the owner.

B. Provide the following data:

1. Test representative material samples proposed for use.
2. Topsoil:

a. pH factor.
b. Mechanical analysis.
c. Percentage of organic content.
d. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

1.3 SUBMITTALS

A. Submit seed vendor's certification for required grass seed mixture, indicating percentage by weight, 100% PLS, germination, and weed seed for each grass species as indicated on plans.

B. Submit the following material samples:

1. Seed
2. Hydromulch

C. Submit the following materials certification:

1. Fertilizer(s) analysis
2. Tackifier

a. Submit materials test report.

D. Upon seeded lawn review, submit written maintenance instructions recommending procedures for maintenance of seeded lawns.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver seed and fertilizer materials in original unopened containers, showing weight, analysis, and name of manufacturer. Store in a manner to prevent wetting and deterioration.

1.5 PROJECT CONDITIONS

A. Work notification: Notify Owner at least 7 working days prior to start of seeding operations.

B. Protect existing utilities, paving, and other facilities from damage caused by seeding operations.

C. Perform seeding work only after planting and other work affecting ground surface has been completed.

D. Restrict traffic from lawn areas until grass is established. Erect signs and barriers as required.

E. Provide water, hose and lawn watering equipment as required.

1.6 WARRANTY

A. Provide a uniform stand of grass by watering, mowing, and maintaining seeded areas until final acceptance. Reseed areas, with specified materials, which fail to provide a uniform stand of grass until all affected areas are reviewed by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lawn seed: Fresh, clean, and new crop seed mixture.

1. Hydromulched Common Bermuda grass seed (Cynodon dactylon) shall be high quality, extra fancy, hulled and treated lawn type seed, at 98% purity and 85% germination, delivered to site in original and unopened containers meeting all requirements of the Arkansas State Seed Law.
2. Hydromulched Annual Rye shall be of high quality, extra fancy, hulled and treated lawn type seed, at 98% purity and 90% germination, meeting all requirements of the Arkansas State Seed Law.
3. Hydromulched Browntop Millet shall be of high quality, extra fancy, hulled and treated lawn type seed, at 98% purity and 90% germination, meeting all requirements of the Arkansas State Seed Law
4. Noxious weed shall not exceed 1/2 per cent by weight of the total pure alive seed and other material in the mixture. Containers containing Johnson grass, nutgrass or other noxious weed seed shall be rejected.

B. Fertilizer: Granular, non-burning product composed of not less than 50% organic slow

acting, guaranteed analysis professional fertilizer.

1. Type A: Starter fertilizer containing 20% nitrogen, 26% phosphoric acid, and 6% potash by weight, or similar approved composition.
2. Type B: Top dressing fertilizer containing 31% nitrogen, 3% phosphoric acid, and 10% potash by weight or similar approved composition.

C. Wood cellulose fiber mulch: Degradable green dyed wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydromulching.

D. Tackifier: Liquid concentrate diluted with water forming a transparent 3 dimensional film like crust permeable to water and air and containing no agents toxic to seed germination.

E. Water: Free of substance harmful to seed growth. Hoses or other methods of transportation furnished by contractor.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine finish surfaces, grades, topsoil quality, and depth. Do not start seeding work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Limit preparation to areas which will be immediately seeded.

B. Loosen topsoil of lawn areas to minimum depth of 2". Remove stones over 1" in any dimension and sticks, roots, rubbish, and extraneous matter.

C. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture. Roll and rake, remove ridges, and fill depressions as required to drain.

D. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to seeding.

3.3 INSTALLATION

A. Hydroseed as follows to ensure complete coverage as noted:

1. Seed:

a. Bermuda seed – 6 lbs per 1000 square feet.

1) Seeding completed between April 01 and September 30th.

b. Annual Rye seed – 6 lbs per 1000 square feet.

1) Seeding completed between October 1 and March 30th.

2. Wood Cellulose fiber hydromulch – 75 lbs. per 1000 square feet. Spray after seed is placed ensuring direct contact with soil. Only provide wood cellulose fiber mulch in areas without erosion control blankets.
3. Erosion control blankets on all slopes 3:1 or greater:

a. BioD-Mat 40 – Rolanka International, Inc. or approved equal.

B. Seed all grass areas, unless otherwise indicated, within limit of construction and areas adjoining seeding limit of construction as a result of seeding operation.

C. Seed immediately after preparation of bed. Do not spray outside of lawn areas; protect all areas not scheduled to receive hydroseed.

D. Remove and clean immediately all hydromulch from walls, trees, shrubs, curbs, pavement, fire hydrants, light and utility poles and other site improvements immediately after hydromulch operation.

E. Hydromulch shall be sprayed over the tilled soil providing a uniform cover.

F. Should Annual Rye grass be seeded, the Contractor shall return to the site on a date as approved by Owner, to remove by mowing to the ground all traces of the Annual Rye. The Landscape Contractor shall then prepare the area for seeding as specified in Part 3.2 of this section. Immediately thereafter, hydroseed and establish the Grass as specified.

G. The Owner and Landscape Architect shall be consulted prior to seeding to review hydroseeding installation.

3.4 MAINTENANCE

A. Maintain the seeded lawns until Substantial Completion of the entire project. Upon Substantial Completion, the Owner will assume lawn maintenance as recommended by the written maintenance instructions submitted by the Landscape Contractor.

B. Water 2 times a week or as required to maintain adequate surface soil moisture for proper seed germination. Continue watering or as required for not less than 30 days. Thereafter apply 1/2" of water twice weekly or as required until acceptance.

C. Repair, rework, and re-seed all areas that have washed out, are eroded, or do not catch.

D. Maintain seeded banks, ditches, medians, and fields to the extent of establishment only. Re-grade and re-seed washed out or eroded areas as required until a suitable cover is established.

3.5 SUBSTANTIAL COMPLETION

A. An inspection of the seeded lawns will be made by the Owner upon request for Application of Substantial Completion by the Landscape Contractor. Provide notification at least five (5) working days before requested inspection date.

3.6 FINAL COMPLETION

A. An inspection of the seeding will be made by the Owner upon request for Final Completion. Provide notification of at least five (5) working days before requested inspection date. Seeded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, uniform, close stand of the specified grass is established free of weeds, undesirable grass species, disease, and insects.

B. No individual lawn areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas, in areas requested to be inspected.

3.7 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from seeding operation.

END OF SECTION

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping joining materials.
2. Dielectric fittings.
3. Sleeves.
4. Identification devices.
5. Grout.
6. Piping system common requirements.
7. Concrete bases.
8. Metal supports and anchorages.

1.2 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D2235.
2. CPVC Piping: ASTM F493.
3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
4. PVC to ABS Piping Transition: ASTM D3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system

fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description: Factory fabricated, union, NPS 2 and smaller:

a. Pressure Rating: 250 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Description Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger:

a. Pressure Rating: 300 psig.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:

1. Description Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller:

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded.

E. Dielectric Nipples:

1. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded or grooved.

2.3 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220500 "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.4 IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

B. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

D. Pipes with OD, including Insulation, Less than 6 inches:

1. Full-band pipe markers, extending 360 degrees around pipe at each location.

E. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

F. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

G. Pipes with OD, including Insultation, 6 inches and Larger:

1. Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering:

1. Use piping system terms indicated and abbreviate only as necessary for each application length.

a. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

I. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

J. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material:

    a. 0.032-inch-thick, aluminum.
    b. 0.0375-inch-thick stainless steel.
    c. 3/32-inch-thick plastic laminate with 2 black surfaces and a white inner layer.
    d. Valve manufacturer's standard solid plastic.

2. Size: 1-1/2 inches in diameter, unless otherwise indicated.
3. Shape: As indicated for each piping system.

K. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

L. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness:

    a. 1/8 inch unless otherwise indicated.
    b. 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.

3. Fasteners: Self-tapping, stainless steel screws or contact-type permanent adhesive.

M. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

2.5 GROUT

A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement

grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts for Main Lines:

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): 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. Cast-Iron Cleanouts for RV Stalls:

1. Description: 4” RV Female Footloose Sewer Cap (White), Enviro Design Products or equal. Submit shop drawing.
2. Sewer Pipe Fitting and Riser to Cleanout: Schedule 40 PVC

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric couplings or dielectric nipples.
2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric nipples.

3.2 INSTALLATION OF PIPING

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination

Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. Pipe Sleeves: PVC. For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 appendixes.
3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
5. PVC Nonpressure Piping: Join according to ASTM D2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D3138Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 INSTALLATION OF EQUIPMENT

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
3. Locate pipe markers on exposed piping according to the following:

a. Near each valve and control device.
b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
d. At manholes and similar access points that permit view of concealed piping.
e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches , and proportionately larger lettering for greater distances. Provide secondary lettering

two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 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 deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

END OF SECTION

SECTION 330513 - MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular precast concrete manhole and structures with tongue-and-groove joints, cover frame, covers, anchorage, and accessories. For junction box and inlet structure, and detention basin.
2. Bedding and cover materials.

B. Related Sections:

1. Section 32 0523 - Concrete for Exterior Improvements: Concrete for manhole and structure base pad construction.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 318 - Building Code Requirements for Structural Concrete.
2. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

B. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C55 - Standard Specification for Concrete Brick.
6. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
7. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
8. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
9. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
10. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
11. ASTM D3753 - Standard Specification for Glass-Fiber-Reinforced Polyester

1.3 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.

C. Design of Joints for Precast Components: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

1.4 SUBMITTALS

A. Shop Drawings: Indicate manhole and structure locations, elevations, piping, and sizes and elevations of penetrations.

B. Product Data: Submit cover and frame construction, features, configuration, and dimensions.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the City of Jonesboro's applicable standards requirements and the Arkansas Department of Transportation (ARDOT) Standard Specifications.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with precast concrete manufacturer’s instructions for unloading, storing and moving precast manholes and structures.

B. Store precast concrete manholes and structures to prevent damage to Owner’s property or other public or private property. Repair property damaged from materials storage.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: ACI 530.

PART 2 - PRODUCTS

2.1 MANHOLES AND STRUCTURES

A. Manufactures

1. Precast Manhole square manhole.

a. Hanson Pipe and Products, Inc, 48-inch square manhole or equal.

B. Manhole and Structure Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923 or cast-in-place (submit shop drawings for cast-in-place reinforcement and dimensions) .

C. Mortar and Grout: As specified in Section 040511, Masonry Mortar and Grout. Type S.

D. Reinforcement: As specified in Section 320523, Concrete for Exterior Improvements.

2.2 FRAMES AND COVERS

A. Refer to Drawings for frame, grates, and covers required for each manhole and structure.

B. Product Description: Cast iron construction, machined flat bearing surface and as shown on the Drawings.

2.3 COMPONENTS

A. Manhole Steps: corrosion resistant, coated, and reinforced with steel per ASTM C-478. Steel reinforcing minimum 1/2" diameter. Formed integral with manhole and structure sections.

2.4 CONFIGURATION

A. Shaft Constructions: As indicated on the Drawings, lipped male/female joints; sleeved to receive pipe sections.

B. Shape: As indicated on the Drawings.

C. Clear Inside Dimensions: As indicated on the Drawings.

D. Design Depth: As indicated on Drawings.

E. Clear Cover Opening: As indicated on Drawings.

F. Pipe Entry: Furnish openings as indicated on Drawings.

G. Steps: As required by code.

2.5 BEDDING AND COVER MATERIALS

A. Refer to Section 312116, Trenching.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

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

C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:

1. Excavate for manholes and structures in accordance with Section 312000 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes and structures in dry trench.
3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Place base pad, trowel top surface level.

C. Place manhole and structure sections plumb and level, trim to correct elevations, anchor to base pad.

D. Backfill excavations for manholes and structures in accordance with Section 312000.

E. Form and place manhole and structures cylinder plumb and level, to correct dimensions and elevations.

F. Cut and fit for pipe sections.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to

form continuous drainage channel as indicated on Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

I. Coordinate with other sections of Work to provide correct size, shape, and location.

3.4 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Lift precast components at lifting points designated by manufacturer.

B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 312000 and 312116 or on other support system shown on Drawings.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer’s plant.

G. Verify manholes and structures installed satisfy required alignment and grade.

H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.

I. Cut pipe to finish flush with interior of structure.

J. Shape inverts through manhole and structures as shown on Drawings.

3.5 FRAME AND COVER INSTALLATION

A. Set frames using mortar and pre-cast concrete rings. Install precast reinforced concrete rings. Lay precast concrete rings in full bed of mortar and completely fill joints.

3.6 FIELD QUALITY CONTROL

A. Test cast-in-place concrete in accordance with Section 32 0523 Concrete for Exterior Improvements.

B. Vertical Adjustment of Existing Manholes and Structures:

1. Where required, adjust top elevation of existing manholes and structures to finished grades shown on Drawings.
2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for

installation of castings.

3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.
4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 32 0523.

END OF SECTION

SECTION 331000 - SITE WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for site water line including domestic water line and fire water line
2. Valves.
3. Hydrants.
4. Positive displacement meters.
5. Backflow preventers.
6. Underground pipe markers.
7. Precast concrete vault.
8. Bedding and cover materials.

B. Related Sections:

1. Section 312000 "Earth Moving" for product and execution requirements for excavation and backfill required by this section.
2. Section 312116 "Trenching" for execution requirements for trenching required by this section.
3. Section 331100 "Water Service Connections" for connections for domestic water service 2 inches or smaller.
4. Section 331200 "Disinfection of Water Distribution" for disinfection of site service utility water piping.
5. Section 320523 "Concrete for Exterior Improvements" for concrete for thrust restraints.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers

D. ASTM International:

1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
2. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
7. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
8. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
9. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
10. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
11. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
12. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding

F. American Water Works Association:

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
5. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C502 - Dry-Barrel Fire Hydrants.
7. AWWA C504 - Rubber-Sealed Butterfly Valves.
8. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in. (50 mm) Through 24 in. (600 mm) NPS.
9. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
10. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
11. AWWA C606 - Grooved and Shouldered Joints.
12. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
13. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
14. AWWA C702 - Cold-Water Meters - Compound Type.
15. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water

Meters.

16. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
17. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.
18. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance

G. Underwriters Laboratories Inc.:

1. UL 246 - Hydrants for Fire - Protection Service

1.3 SUBMITTALS

A. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

1.5 QUALITY ASSURANCE

A. Deliver and store valves in shipping containers with labeling in place.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 WATER PIPING

A. Ductile Iron Pipe: AWWA C151: AWWA C104:

1. Fittings: Ductile iron, standard thickness.
2. Joints: Mechanical joint or flanged as indicated, or AWWA C111, rubber gasket with rods.
3. Jackets: AWWA C105 polyethylene jacket, Double layer, half lapped, 10 mil polyethylene tape.

B. Copper Tubing: ASTM B88, Type K, annealed:

1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.

2. Joints: Compression connection or AWS A5.8, BCuP silver braze.

C. PVC Pipe: ASTM D1784 and CS Type 1, Grade 1 or Grade 2, Polyvinyl Chloride Plastic. Pipe shall conform to ASTM D2241, SDR Pressure Class 250:

1. Fittings shall be in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.
2. Joints shall be in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

2.2 GATE VALVES

A. Manufacturers include: American Darling, Mueller, Smith Metropolitan, or Approved Equal.

B. 2-1/2 inches and Smaller: Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression IPS ends, with control rod, post indicator, extension box and valve key.

C. 3 inches and Larger: AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged mechanical joint ends, control rod, post indicator, extension box and valve key.

2.3 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire: 12-gauge insulated copper wire, insulating jacket shall be a minimum of 30 mil polyethylene complying with ASTM-D-1248, 30 volt rating, brightly colored plastic covering, imprinted with "Water Service" in large letters.

2.4 TAPPING SLEEVES

A. Sleeves may be iron or steel. Tapping sleeves shall be designed for a working pressure of at least 175-psi and a test pressure as required for the project (225 psi or greater as required). Fabricated steel sleeves shall be Type 304 stainless steel OR carbon steel coated with high build Thermo-Set Epoxy. A test plug shall be furnished through the body for hydrostatic pressure testing on all sleeves. The outlets shall conform to ANSI B16.1, Class 125 flanges designed to accept tapping valves described herein. All bolts shall be of corrosion resistant alloy. Sleeves may be designed for a watertight seal by the use of mechanical followers or by the use of a gasket placed in a recess between the sleeve body and the pipe barrel. Only sleeves with mechanical followers or full circle gaskets may be used for full size taps. The use of other type sleeves is restricted to taps where the branch is at least one size smaller than the run.

2.5 BEDDING AND COVER MATERIALS

A. Bedding: As indicated on Drawings.

B. Cover: As indicated on the Drawings.

C. Soil Backfill from Above Pipe to Finish Grade: As indicated on the Drawings

2.6 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 32 0523.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 33 1100 for Work of this Section.

B. Form and place concrete for pipe thrust restraints at change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil as indicated on the Drawings.

C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent of Standard Proctor.

D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent

3.4 INSTALLATION – PIPE

A. Maintain separation of water main from sewer piping in accordance with Arkansas Department of Health requirements and in accordance with the below:

1. All water mains are to cross over sewer mains with a minimum of 18-in of vertical separation and water and sewer mains shall have a minimum of 10-ft horizontal separation.
2. Where 18-in of separation cannot be achieved, the water or sewer main shall be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing.

3. Where a water main must unavoidably pass beneath the sewer line, at least 18 in of separation must be maintained between the outside of the two pipes in addition to either the water or sewer main being encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing.

B. Install pipe to indicated elevation to within tolerance of 1 inch.

C. Install ductile iron piping and fittings to AWWA C600.

D. Route pipe in straight line as indicated.

E. Install pipe to allow for expansion and contraction without stressing pipe or joints.

F. Install access fittings to permit disinfection of water system performed under Section 02516.

G. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

H. Establish elevations of buried piping with not less than 2.5ft of cover.

I. Install trace wire continuous buried 6 inches below finish grade, above pipe line; coordinate with Section 33 1100.

J. Backfill trench in accordance with Section 31 2116.

3.5 INSTALLATION – VALVES AND HYDRANTS

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade

3.6 TAPPING SLEEVES AND VALVES

A. The pipe shall be free of dirt and other debris before attaching tapping sleeve or tapping saddle. That part of the pipe barrel, other than concrete pipe, which will be in contact with the gasket of tapping saddles, shall be smooth. All rough areas on the pipe barrel shall be smoothed. The CONTRACTOR shall field verify all pipe and fitting dimensions. Tapping sleeve, tapping saddle, or direct tap shall be installed at least twenty-four (24) inches from bell joints, fittings, end of pipe joint, or another tap.

B. Tapping saddles or sleeves shall be bolted securely to the pipe. The face of the outlet shall be plumb. Mechanical joint glands for tapping sleeves shall be installed. The strap bolts for tapping saddles shall be alternately tightened "snug" and then alternately tightened to a torque of 100 foot-pounds.

C. The tapping valve shall be bolted securely to the tapping sleeve or tapping saddle outlet flange. The tapping valve shall be adequately supported from beneath. The weight of the tapping valve shall not be supported by the tapping sleeve/saddle. A concrete “mud slab” at least six (6) inches thick shall be poured under the location of all tapping valves 14 inches and larger and the weight of the valve shall be supported by the mud slab.

The tapping machine shall be bolted securely to the valve.

D. After installation of the tapping sleeve or saddle and the tapping valve and before drilling through the pipe, the assembly shall be hydrostatically tested at the pressure specified by the City of Jonesboro's water department, by introducing water through the sleeve or saddle test tap.

E. The pilot drill and shell cutter shall be in good condition. The pilot, shell cutter, and any other component of the tapping machine that will or may come into contact with the interior of the tap valve, tap saddle, or potable water pipe, shall be thoroughly sterilized with straight bleach or super-chlorinated solution. The shell cutter shall be the size required to cut the full opening specified.

F. Only qualified operators shall operate the tapping machine. The "coupon" shall be withdrawn and be given to the ENGINEER for inspection. Care shall be exercised to avoid drilling or cutting the backside of the pipe by carefully assuring the engagement of the pilot drill and shell cutter shaft.

G. Openings in the pipe barrel for tapping saddles installed on dry pipe shall be cut with a pilot drill and shell cutter. Torch cutting is not permitted.

H. Tapping operations must not commence before inspection by the ENGINEER or his authorized representative. Tapping operations must not commence before the tapping assembly has passed a pressure test as required by the City of Jonesboro's water department.

I. A thick coat of coal tar epoxy or other approved bituminous material shall be applied to the straps and bolts of saddles after installation and cleaning or by enclosing polyethylene material in accordance with the City of Jonesboro's water department requirements.

J. Tapping saddles and sleeves with a run size 2" or larger shall be adequately thrust blocked with concrete.

3.7 SERVICE CONNECTIONS

A. Install water service in shall be in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Install water meter and backflow preventer in concrete vault located on site.

C. Install water service to 5 feet of building. Connect to building water service.

D. Install Work in shall be in accordance with the project specifications or City of Jonesboro's standard specifications - whichever is more stringent, City of Jonesboro's Fire Department, and Arkansas Department of Health's standards.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 1200.

3.9 HYDROSTATIC PRESSURE AND LEAKAGE TESTS

A. Testing shall begin within five (5) days after the completion of the installation of the water main (on a per main or per section/area basis). Once pressure testing is begun, it shall be vigorously pursued until complete. After the pipelines or isolated sections of the pipeline have been filled with water and air purged, the pressure shall be increased to the test pressure by means of a pump.

B. The CONTRACTOR shall furnish a pump and appurtenances as described in Section 34 herein. The OWNER will furnish the meter and pressure gauge after the CONTRACTOR has satisfied himself that the line will pass the test. The CONTRACTOR shall furnish all labor for conducting the tests.

C. The test pressure shall be 225 psi at the highest point of the pipeline segment being tested or as otherwise specified by the ENGINEER. All pipelines, service lines, and appurtenances shall be tested. The pressure test shall be documented and documentation shall be provided to the AE and the City of Jonesboro's water department for review and approval.

D. The duration of the hydrostatic leakage test shall be two (2) hours or as specified by the ENGINEER.

1. The duration of the hydrostatic leakage test on tapping sleeves/saddles shall be thirty (30) minutes at 225 psi with zero leakage.

E. The source of water for the pump suction shall be potable water from the OWNER'S distribution system. The vessel used must be approved by the ENGINEER.

F. All interior valves including guardian valves on fire hydrants and other appurtenances shall be open during all tests.

G. After the specified test pressure has been applied the entire pipeline shall be checked in the presence of the ENGINEER giving particular attention to that part of the pipeline and those appurtenances that are exposed.

H. If leaks are apparent, the CONTRACTOR shall, at his own expense, perform whatever work and/or replace whatever material that is required in order to remedy the defect and stop the leaks. All corrective work shall be approved by the ENGINEER.

I. After the CONTRACTOR has taken the necessary action to repair or replace any part of the pipeline or appurtenances where leaks were apparent or if no leaks were apparent, the pipelines shall be subjected to a leakage test at the pressure specified with a meter inserted in the test pump discharge line.

J. 1. The maximum leakage per hour for jointed pipe (ductile iron, PVC, concrete pipe, etc.) shall be as calculated from the following formula:

1. All rubber gasket or O-ring joints

a. $Q = LD \sqrt{P} / 148,000$
b. Q = Quantity of makeup water (gallons per hour)
c. L = Length of pipe section being tested (feet)
d. D = Nominal pipe diameter (inches)

e. P = Test pressure (psi); 225 psi or as specified by the ENGINEER

2. The maximum leakage per hour for non-jointed pipe (welded steel, welded PVC, welded HDPE, etc., and containing gasket-jointed connections for fittings, valves, etc.) shall be as calculated form the following formula:

a. Q = ND √ P / 7,400
b. Q = Quantity of makeup water (gallons per hour)
c. N = Summation of mechanical and push-on gasket joints in length of pipe tested
d. D = Nominal pipe diameter (inches)
e. P = Test pressure (psi); 225 psi or as specified by the ENGINEER

3. The test pressure shall not vary by more than ± five (5) psi for the duration of the test. During the duration of the two-hour test, if the test pressure drops more than 5.0 psi from the start pressure, the test shall be terminated and considered failure due to assumed leaks in the tested pipe section. If the pressure rises beyond the allowed 5 psi variance, the test shall be terminated and remaining air shall be purged from the pipeline.
4. Upon completion of a two-hour test where the test pressure did not vary by more than ± five (5) psi, the CONTRACTOR shall determine the leakage amount by measuring the amount of "make-up" water necessary to restore the original starting pressure.

K. If any test of pipe laid discloses leakage greater than the allowable leakage as calculated from the above formula(s), the CONTRACTOR shall, at his expense, locate the leak or leaks and perform whatever work and/or replace whatever material that is required in order to remedy the defect(s) and stop the leak(s). All corrective work must be approved by the ENGINEER. Tests on tapping sleeves/saddles must have zero leakage to be considered successful.

3.10 TEST PUMP

A. The CONTRACTOR shall provide a water pump for testing the mains hydrostatically. The pump shall have the following features:

1. Designed so that the required test pressures can be attained.
2. RESERVED
3. The pump discharge shall be equipped with the following, in the order listed from the pump outward (see CAW Standard Detail Sheet):

a. Check valve arranged so as to prevent flow back toward pump.
b. Adjustable pressure regulating device capable of maintaining discharge pressure at a constant level.
c. Valved exhaust outlet.
d. Section of flexible hose - length sufficient that ends of hose rests on ground.
e. Outlet for pressure gauge. Outlet shall be equipped with valve and surge dampening device. Connection for gauge shall be 1/4" F.I.P. The pressure gauge will be furnished by the OWNER.

4. The pump suction shall be equipped with the following from the pump outward

(see CAW Standard Detail Sheet):

a. Suction pipe.
b. Straight meter coupling - 1/2" M.I.P. x 5/8" Meter Nut.
c. 5/8" meter - furnished by owner
d. Straight meter coupling - 1/2" M.I.P. x 5/8" Meter Nut.
e. End screen to prohibit entry of foreign matter if pump suction is connected to a vessel instead of on a water main.

B. The CONTRACTOR shall provide all other necessary connections for connecting pump from the suction source and to the main being tested.

3.11 FIELD QUALITY CONTROL

A. Perform pressure test on domestic site water distribution system in in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION

SECTION 331100 - WATER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for domestic water service connections to buildings.
2. Corporation stop assembly.
3. Curb stop assembly.
4. Meter setting equipment.
5. Water meters.
6. Backflow preventers.
7. Underground pipe markers.
8. Precast concrete vault.
9. Bedding and cover materials.

B. Related Sections:

1. Section 312000 "Earth Moving"
2. Section 312116 "Trenching"
3. Section 331000 "Site Water Distribution"
4. Section 331200 "Disinfection of Water Distribution"

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.

D. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

4. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
5. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
6. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
7. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
8. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
9. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding

F. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
2. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
3. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
4. AWWA C702 - Cold-Water Meters - Compound Type.
5. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
6. AWWA C800 - Underground Service Line Valves and Fittings.
7. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.
8. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.3 SUBMITTALS

A. Shop Drawings: Provide shop drawings for precast concrete vaults to include detail drawings showing the vault and accessories.

B. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the project specifications or City of Jonesboro's standard specifications – whichever is more stringent, City of Jonesboro's Fire Department, and the Arkansas Department of Health's standards and requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.

B. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.

C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Copper Tubing: ASTM B88 Type K annealed:

1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
2. Joints: Compression connection or AWS A5.8, BCuP silver braze.

2.2 CORPORATION STOP ASSEMBLY

A. Furnish materials accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Corporation Stops:

1. Brass or red brass alloy body conforming to ASTM B62.
2. Inlet end threaded for tapping according to AWWA C800.
3. Outlet end suitable for service pipe specified.

C. Service Saddles:

1. Double strap type, designed to hold pressures in excess pipe working pressure

2.3 CURB STOP ASSEMBLY

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Curb Stops:

1. Brass or red brass alloy body conforming to ASTM B62.
2. Plug type valve.
3. Positive pressure sealing.

2.4 METER SETTING EQUIPMENT

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

2.5 WATER METERS

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Provide meter as indicated on Drawings.

2.6 BACKFLOW PREVENTERS

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Reduced Pressure Backflow Preventers:

1. Comply with ASSE 1013.
2. Bronze body, with bronze internal parts and stainless steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

C. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.7 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

C. Trace Wire: 12-gauge insulated copper wire, insulating jacket shall be a minimum of 30 mil polyethylene complying with ASTM-D-1248, 30 volt rating, brightly colored plastic covering, imprinted with “Water Service” in large letters.

2.8 PRECAST CONCRETE VAULT

A. Furnish materials in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

B. Product Description: Precast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

C. Shape: As indicated on Drawings.

2.9 BEDDING AND COVER MATERIALS

A. Bedding: As indicated on Drawings

B. Cover: As indicated on Drawings

2.10 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 32 0523.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION – CORPORATION STOP ASSEMBLY

A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the Architect/Engineer.

B. Provide service clamps for mains other than of cast iron or ductile iron mains.

C. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock position on main's circumference; locate corporation stops at least 12 inches apart longitudinally and staggered.

D. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2 inches width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.

E. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by the Engineer.

3.4 BEDDING

A. Excavate pipe trench in accordance with Section 31 2116.

B. Backfill around sides and to top of pipe in accordance with Section 31 2000.

C. Maintain optimum moisture content of fill material to attain required compaction density.

D. Place fill material in accordance with Section 31 2000.

3.5 INSTALLATION – PIPE AND FITTINGS

A. Maintain separation of water main from sewer in accordance with Arkansas Department of Health requirements and in accordance with the below:

1. All water mains are to cross over sewer mains with a minimum of 18-in of vertical separation and water and sewer mains shall have a minimum of 10-ft horizontal separation.
2. Where 18-in of separation cannot be achieved, the water or sewer main shall be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing.
3. Where a water main must unavoidably pass beneath the sewer line, at least 18-in of separation must be maintained between the outside of the two pipes in addition to either the water or sewer main being encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing.

B. Route pipe in straight line.

C. Install pipe to allow for expansion and contraction without stressing pipe or joints.

D. Install access fittings to permit disinfection of water system performed under Section 02516.

E. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

F. Establish elevations of buried piping with not less than 2.5 ft of cover.

G. Install trace wire continuous, buried 12 inches below finish grade, above pipe line; coordinate with Section 33 1000.

H. Backfill trench in accordance with Section 31 2116

3.6 INSTALLATION – WATER METERS

A. Install Work in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

3.7 INSTALLATION – BACKFLOW PREVENTERS

A. Install backflow preventer where indicated on the Contract Drawings and in accordance with manufacturer's instructions.

B. Comply with City of Jonesboro's requirements and plumbing codes in regards to testing and installation requirements.

3.8 SERVICE CONNECTIONS

A. Install water service in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

3.9 PRECAST CONCRETE VAULT

A. Construct valve vaults of precast concrete.

B. Seal vault joints watertight with preformed plastic joint sealant compound. Apply asphalt waterproofing to exterior walls.

C. Seal annular space between pipe and wall sleeves as indicated on the Contract Drawings.

D. Install vault covers and frames; adjust to finished grade elevation.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 1200.

3.11 FIELD QUALITY CONTROL

A. Perform pressure test on domestic site water distribution system in accordance with the project specifications or City of Jonesboro's standard specifications, whichever is more stringent.

END OF SECTION

SECTION 331200 - DISINFECTION OF WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes disinfection of potable water distribution system; and testing and reporting results.

B. Related Sections:

1. Section 33 1000 "Site Water Distribution" Product and Execution requirements for installation, testing, of site domestic water distribution piping.

1.2 REFERENCES

A. American Water Works Association:

1. AWWA B300 - Hypochlorites.
2. AWWA B301 - Liquid Chlorine.
3. AWWA B302 - Ammonium Sulfate.
4. AWWA B303 - Sodium Chlorite.
5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
6. AWWA C651 - Disinfecting Water Mains.

1.3 SUBMITTALS

A. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

B. Test Reports: Indicate results comparative to specified requirements of the Arkansas Department of Health.

C. Certificate: Certify cleanliness of water distribution system meets or exceeds Arkansas Department of Health Standards

1.4 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

B. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards of the Arkansas Department of Health.

C. Water Quality Certificate: Certify water conforms to quality standards of the Arkansas Department of Health, suitable for human consumption.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the Project Specifications and City of Jonesboro's standards, whichever is more stringent.

1.6 QUALIFICATIONS

A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this section with minimum three years of experience.

B. Testing Firm: Arkansas Department of Health

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300 Hypochlorite, AWWA B301 Liquid Chlorine.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping system has been cleaned, inspected, and pressure tested

B. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 DISINFECTION REQUIREMENTS

A. Testing shall begin within five (5) days after the completion of the pressure testing of the water main (on a per main or per section/area basis). Blowoff and sample points shall be constructed by the CONTRACTOR as shown on the Plans or as directed by the ENGINEER. Fire hydrants shall be utilized as blowoff points whenever possible. Fire hydrants are not satisfactory for sample points. Openings for sample points shall be 1" copper riser pipe that extends well above the surface, as shown on the CAW Standard Details. A flushing plan shall be so designed so that all samples may be taken on each trip. The lines shall not be considered acceptable until two (2) consecutive samples taken twenty-four (24) hours apart are negative. Sampling may commence only Monday through Thursday. First samples may not be collected on Fridays, Saturdays, Sundays, and official holidays.

B. There are two acceptable methods of disinfecting: continuous feed method using liquid chlorine or calcium hypochlorite and the slug method using liquid chlorine or calcium hypochlorite. The slug method applies to large mains and shall be used only on approval of the ENGINEER. Liquid chlorine shall be used only when the CONTRACTOR has suitable equipment available and employees who are familiar with the physiological, chemical and physical properties and who are properly trained and equipped to handle any emergency that may arise. If, in the opinion of the ENGINEER, the equipment is inadequate or the personnel are not qualified, this method shall not be used.

C. When the continuous feed or slug method is to be used, the pipelines and appurtenances shall be thoroughly flushed prior to disinfecting. The flushing plan shall be approved by the ENGINEER. The ENGINEER may halt or reduce flushing if the distribution system pressures are reduced by the flushing operations.

D. The CONTRACTOR is reminded that chlorine is a powerful oxidant and reacts readily with foreign substances. All chlorine compounds shall be handled and stored in accordance with manufacturer's recommendations. Breathing of chlorine gas can be fatal. Hypochlorite solutions should not come into contact with skin or clothing. Containers used for mixing hypochlorite solution shall be clean and dry.

E. When the continuous flow method is used, the final concentration of chlorine inside the main shall be 50 parts per million. When the slug method is used, the concentration of chlorine entering the pipeline shall be at least 300 to 400 parts per million (ppm) and be of sufficient size/length to provide a minimum of two (2) hours of contact time as it flows through the pipeline. The strength/concentration of the slug shall be monitored as it flows through the pipeline and at no time shall it be allowed to drop below 100 ppm. If at any time the concentration of the slug nears 100 ppm, the flow shall be stopped, chlorination equipment shall be relocated to the head of the slug, and as flow resumes, chlorine shall be applied to restore the chlorine concentration of the slug to at least 300 ppm.

F. Calcium hypochlorite shall contain at least 60% available chlorine by weight in granular form.

G. When the continuous feed or slug method is used and the source of the chlorine is calcium hypochlorite, a solution of hypochlorite and water shall be prepared by mixing thoroughly in a suitable container. The mix shall contain one (1) pound of calcium

hypochlorite per gallon of water. A suitable pump shall be provided for pumping this solution into the pipelines to be disinfected. This pump shall be equipped with a flow-measuring device.

H. When liquid chlorine is used, the equipment for injection shall consist of a solution feed chlorinator in combination with a booster pump for injecting the chlorine-gas water solution into the pipeline. Introduction of chlorine-gas directly from the supply cylinder shall not be permitted. The pump shall be equipped with a flow-measuring device.

I. During application of any chlorine solution, care shall be taken to assure that the solution does not flow back into the distribution system.

J. The procedure for disinfecting by the continuous flow method shall be as follows:

1. The flow through the pipeline and the solution flow shall be regulated so that the required concentration of chlorine is attained. The flow through the main shall be measured by using a pitot gauge or meter.
2. The introduction of the solution shall be continuous until the desired concentration is attained throughout the pipe line system. The concentration shall be checked by the Drop Dilution Method
3. After the required concentration has been attained all internal valves shall be operated in order to assure that the solution comes in contact with all appurtenances.
4. The solution shall remain in the pipe line system for twenty-four (24) hours after which the pipelines shall be thoroughly flushed. The chlorine concentration shall be checked before flushing. If the concentration is less than 25 parts per million, the disinfecting procedure shall be repeated if directed by the ENGINEER.

K. The procedure for disinfecting by the slug method shall be the same as the continuous flow method except that the flow rates shall be regulated so that the specified concentration of chlorine shall be in contact with all parts of the pipe line for at least two (2) hours.

L. Disinfecting by the tablet method is not allowed by the Arkansas Department of Health.

M. After final flushing, samples of water shall be collected from the sample points provided by the CONTRACTOR and tested by the OWNER. The CONTRACTOR shall provide any assistance required in collecting the samples.

N. If any of the samples collected are positive, the disinfecting procedures shall be repeated as directed by the ENGINEER until negative samples are collected. Only the continuous flow or slug method may be used.

O. The cost of water used for flushing after positive samples have been collected shall be deducted from amounts due the CONTRACTOR. The amount used shall be determined by measurements of flow using a pitot gauge. Payment shall be based on the lowest prevailing water rate.

P. Payments to the CONTRACTOR (or DEVELOPER if a SPECIAL CONTRACT) shall be reduced by $30.00 per sample for each positive sample collected to cover the cost of collecting and testing the samples.

Q. Any chlorinated water release that would cause a chlorine residual above 0.10 ppm in a body of water containing any aquatic life forms shall be de-chlorinated as needed to prevent the resultant chlorine level from exceeding the 0.10 ppm limit. Chemicals used in the de-chlorination process shall not also produce other water qualities that would be harmful to the aquatic life forms in a receiving body of water; harmful water qualities such as, but not limited to, changes in pH, dissolved oxygen concentrations, etc.

R. Water draining from the sampling points and flushing shall be directed to adequate drainage structures so as not to create a nuisance and to avoid damage to other facilities, structures, and/or property. The CONTRACTOR shall be responsible for any damages.

3.3 FIELD QUALITY CONTROL

A. Disinfection, Flushing, and Sampling:

1. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
2. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.

B. Bacteriological Tests:

1. After final flushing and before pipeline is connected to existing system, or placed in service, two sets of acceptable water samples collected from the new water line and taken on consecutive days shall be submitted by the Contractor to the bacteriological laboratory at the Arkansas Department of Health in Little Rock, Arkansas.
2. Samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater per the American Public Health Association, AWWA, and Water Environment Association (latest edition and shall show the absence of coliform organisms.
3. If samples collected are positive, the disinfecting procedures and samples shall be repeated until two consecutive day samples are tested safe.

END OF SECTION

SECTION 334111 - STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm drainage piping.
2. Accessories.
3. Underground pipe markers.

B. Related Sections:

1. Section 31 2000 "Earth Moving" for backfill and compaction for structures and storm piping.
2. Section 31 2116 "Trenching" for execution requirements for trenching required by this section.
3. Section 32 0523 "Concrete for Exterior Improvements" for concrete type for catch basin base pad construction.
4. Section 33 0513 "Manholes and Structures"

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
5. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
6. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
7. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
8. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
10. ASTM D1557 - Standard Test Method for Laboratory Compaction

Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
11. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
12. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
13. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
14. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
16. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
17. ASTM D6938 - 10 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
18. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
19. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.3 SUBMITTALS

A. Product Data: Submit data indicating pipe, pipe accessories, and appurtenances.

B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, catch basins, structures, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the City of Jonesboro’s applicable standards requirements.

1.6 COORDINATION

A. Coordinate the Work with termination of storm sewer connection outside building, trenching, and to the connection to municipal storm sewer utility service.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Polyethylene Pipe:

1. Piping and fittings shall be ADS N ST IB pipe as manufactured by Advanced Drainage Systems (ADS) of Hilliard, OH, or equal.
2. Piping and fittings shall have a smooth interior and annular exterior corrugations.
3. Pipe shall be manufactured in accordance with AASHTO M252, Type S or SP for 4-inch through 10-inch diameter, and AASHTO M294 or ASTM F2306 for 12-inch through 60-inch diameter.
4. Pipe shall be joined using a bell and spigot joint meeting AASHTO M252, AASHTO M294 or ASTM F2306. The joint shall be soil-tight and gaskets shall meet the requirements of ASTM F477.
5. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.
6. Virgin material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch diameters, or 435400C for 12- through 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch virgin pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.

B. Perforated Pipe for Underdrains:

1. Piping and fittings shall be perforated ADS single wall corrugated HDPE pipe as manufactured by Advanced Drainage Systems (ADS) of Hilliard, OH, or equal.
2. Perforations shall be Type B pattern as specified by ADS. Contractor shall obtain approval if perforation pattern other than Type B is to be used.
3. Perforated pipe shall be wrapped in geotextile fabric. Fabric shall be 4-oz non-woven geotextile fabric, Mirafi 140N or equivalent.

C. Reinforced Concrete Pipe:

1. Reinforced concrete pipe and flared-end sections: ASTM C 76, Type III, tongue and groove joints.
2. Joint material: cold-applied preformed plastic gasket type sealant conforming to ASTM C 443.

2.2 ACCESSORIES

A. Filter Fabric: Non-biodegradable, non-woven, 6 oz minimum weight.

B. Grout: Specified in Section 320523.

2.3 UNDERGROUND PIPE MARKERS

A. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Storm Sewer Service" in large letters.

2.4 CATCH BASINS

A. Refer to Section 33 0513 Manholes and Structures and as indicated on the Drawings.

2.5 BEDDING AND COVER MATERIALS

A. Bedding: As indicated on the Drawings.

B. Cover: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 312116 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 8 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM D2321. Seal joints watertight.

B. Place pipe on bedding material as indicated on the Drawings.

C. Lay pipe to slope gradients noted on drawings with maximum variation from indicated slope of 1/8 inch in 10 feet.

D. Place bedding backfill around pipe as indicated on the Drawings.

E. Install trace wire continuous over top of pipe buried 12 inches below finish grade, above pipe line.

F. Install site storm drainage system piping to 5 feet of building. Connect to building storm drainage system.

3.5 INSTALLATION - CATCH BASINS AND STRUCTURES

A. Perform work in accordance with Drawings.

B. Refer to Section 330513, Manholes and Structures.

3.6 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.7 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION